Acta Scientiarum
http://periodicos.uem.br/ojs
ISSN on-line: 1807-8648
https://doi.org/10.4025/actascihealthsci.v48i1.73324

Prevalence of Uncontrolled Hypertension and Its Associated Factors among Healthcare Workers: A Cross-Sectional Study in Southern Iran

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ABSTRACT. Hypertension (HTN) is the leading cause of premature death, making its control crucial. This study aimed to investigate the prevalence of uncontrolled hypertension and its associated factors among healthcare workers in Southern Iran. This cross-sectional study was conducted using the registration data from the Employee Health Cohort Study. Uncontrolled HTN was defined as systolic blood pressure ⩾ 130 mmHg and/or diastolic blood pressure ⩾ 80 mmHg in HTN patients on-treatment. Statistical analysis was performed using logistic regression with a significance level of $p<0.05$. Out of 5,925 healthcare workers, 381 had hypertension, with 358 (93%) receiving treatment. Among those treated, 241 (67%) had uncontrolled HTN. Factors associated with uncontrolled HTN were male sex (OR = 3.05, 95% CI: 1.84 – 5.06), duration of HTN (OR = 1.90, 95% CI:1.03 – 3.48), physical activity (OR = 0.35, 95% CI: 0.18 – 0.66) and diabetes (OR = 0.51, 95% CI: 0.27 – 0.97). This study showed a high prevalence of uncontrolled HTN among health workers in southern Iran. Key associated factors included sex, duration of HTN, physical activity and diabetic. These findings highlight the importance of targeted interventions to address modifiable risk factors and improve the management and control of HTN among healthcare workers.

Keywords: Uncontrolled Hypertension; Prevalence; associated factors;healthcare workers; Iran.

Received on August 13, 2024.
Accepted on June 04, 2025.

Introduction

Hypertension (HTN) is a significant public health issue and is estimated to affect more than 1.2 billion people aged 30 to 79 globally based on World Health Organization reported data in 2021 (Mills et al., 2020). It is a leading cause of worldwide premature death and an undeniable risk factor for the most prevalent non-communicable diseases of the cardiovascular, renal, and nervous systems. These adverse consequences and their considerable financial burden can be avoided by a rapid diagnosis at a relatively low cost. That's why a 33% reduction in the prevalence of HTN till 2030 counted among the sustainable development goal's target (Balouchi et al., 2022).

Previous efforts to control the HTN pandemic in the Middle East are not as successful as the other regions. The awareness and treatment rates did not change significantly over the past over the past three decades, though the prevalence increased significantly and reached about 24.36%, based on a recent meta-analysis (Mohammadian Khonsari et al., 2021; Okati-Aliabad et al., 2022). Despite advances and expansion of antihypertensive options, 50% of diagnosed hypertensive cases are either untreated or undertreated. This high prevalence of uncontrolled HTN suggests a potential for remarkable preventable cardiovascular events (Miao et al., 2020; Nguyen & Chow, 2021).

Besides devastating end-organ sequelae of uncontrolled HTN, the central nervous system (CNS) can be profoundly affected by uncontrolled HTN in both acute (e.g. hypertensive encephalopathy, ischemic stroke, and intracerebral hemorrhage) and chronic settings in which brain damages presented with cognitive deficit (Tomek, 2023).

In another cohort study from Shiraz, Southern Iran, 43.3% of 7225 participants in the age range of 40 to 70 years were hypertensive (Sayadi et al., 2021). Moreover, previous studies reported a relatively poor blood

pressure control rate in Iran. 61.7% of 4394 participants aged 50 to 74 years in the Shahroud Eye Cohort Study suffered from uncontrolled HTN (Arabzadeh et al., 2014; Farhadi et al., 2023).

Considering the high prevalence, burden and catastrophic consequences of uncontrolled HTN, continuous and thorough surveys and surveillance of uncontrolled HTN, its trend, and associated factors are crucial. This study aimed to estimate the prevalence and associated factors of uncontrolled HTN in Shiraz, Southern Iran.

Methods

Design and participant

This was a cross-sectional study conducted on the registration data of the Shiraz University Medical Sciences Employee Health Cohort Study (SUMS EHCS).

SUMS EHCS description

SUMS EHCS is a Persian cohort branch founded in 2017 to investigate non-communicable diseases and identify modifiable risk factors. A team of trained personnel verified that volunteers met the study's inclusion criteria based on the PERSIAN protocol. The inclusion criteria encompassed all healthcare workers aged 20 to 74 at SUMS. Exclusion criteria applied to individuals with physical or psychological disabilities, as well as pregnant women, as they were unable to complete the enrollment process. Upon the participants' arrival at the cohort center, written informed consent was obtained, and documented using credible personal identification documents. Each individual was assigned a unique 12-digit barcode, which was used to label all biological samples and associated documentation. Participants completed a questionnaire on demographics, occupational status, medical history, and personal habits, including smoking and alcohol use. Physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ). Anthropometric measurements such as height, weight, and waist circumference were taken in the morning after a fast (Poustchi et al., 2018). Central and local teams ensured compliance with the PERSIAN Cohort protocol through quality assurance and control measures, which included daily data entry monitoring, periodic reviews for missing information, and surprise inspections at cohort sites.The study adhered to the Helsinki Declaration principles and received approval from the Local Ethics Committee.

Ethical approval

This study was approved by the ethics committee of Shiraz University of Medical Sciences (IR.SUMS.REC.1401.451).

Blood pressure measurement

To measure blood pressure (systolic and diastolic), the In Body BPBIO 320 digital device was used, offering multiple cuff sizes to ensure a proper fit for each participant's arm. Participants were seated for each measurement, with the first reading taken after a minimum of 5 minutes of rest. The second reading was conducted in the same seated position, at least 10 minutes after the first. Blood pressure was measured on both the right and left arms, recording the first and second diastolic (DBP1, DBP2) and systolic (SBP1, SBP2) blood pressures, as well as the first and second resting pulse rates (PR1, PR2), all in mmHg. the average of the second systolic blood pressure measurements from the right and left arms (RightSBP2 and LeftSBP2) was calculated as SBP, and the average of the second diastolic blood pressure measurements from both arms (RightDBP2 and LeftDBP2) was calculated as DBP. Participants were advised against engaging in strenuous activities and consuming heavy food, tea, coffee, alcohol, drugs, or stimulant drinks within half an hour before the measurement. It was also emphasized that they should wear light clothes with wide sleeves so that there is no pressure on the arm when the sleeve is raised.

Definition of uncontrolled HTN

In this study, controlled hypertension (HTN) was defined as systolic blood pressure < 130 millimeters of mercury (mmHg) and diastolic blood pressure <80 mmHg in on-treatment hypertensive patients, while uncontrolled hypertension (HTN) was defined as systolic blood pressure ⩾ 130 mmHg and/or diastolic blood pressure ⩾ 80 mmHg in these patients (Whelton et al., 2018).

Statistical analysis

The statistical analysis was carried out using SPSS software (version 25). Mean and standard deviation were utilized to present quantitative data, while frequency and percentage were used for qualitative data. Univariate and multivariate analysis was conducted using logistic regression. A significance level of $p<0.05$ was considered in the analysis.

Results

In this study, data from 5925 health workers aged 20 to 74 was utilized.381 health workers reported that they were diagnosed with HTN. Of these, 93% (358 individuals) declared that they are on-treatment. The information on the treated patients according to the controlled group and the uncontrolled group is shown in Table 1. 67% (n = 241) of the treated patients were in the uncontrolled group and 33% were in the controlled group.

Table 1. Prevalence ofUntreated, Controlled and Uncontrolled Hypertension Patients in baseline data of EHWC cohort study of SUMS (N = 5925).

Variable	Non-HTN N = 5544	Untreated HTN N = 23	HTN on-treatment (N = 358)	
			Controlled** N = 117	Uncontrolled*** N = 241
Age				
<50	4888 (95.2)	18 (0.4)	77 (1.5)	150 (2.9)
⩾ 50	656 (82.8)	5 (0.6)	40 (5.1)	91 (11.5)
Sex				
Female	3158 (94.5)	11 (0.3)	78 (2.3)	96 (2.9)
Male	2386 (92.4)	12 (0.5)	39 (1.5)	145 (5.6)
Marital status				
Single	841 (96.1)	2 (0.2)	11 (1.3)	21 (2.4)
Married	4482 (93.2)	19 (0.4)	94 (2)	212 (4.4)
Divorced or widow	275 (92.6)	2 (0.7)	12 (4)	8 (2.7)
Education				
Illiterate orelementary	215 (90.3)	2 (0.8)	4 (1.7)	17 (7.1)
Middle	274 (90.7)	2 (0.7)	7 (2.3)	19 (6.3)
High and diploma	1021 (92.5)	5 (0.5)	24 (2.2)	54 (4.9)
College	4034 (94.2)	14 (0.3)	82 (1.9)	151 (3.5)
Family history of HTN				
No	2420 (94)	9 (0.3)	47 (1.8)	98 (3.8)
Yes	3118 (93.2)	14 (0.4)	70 (2.1)	142 (4.2)
Duration of HTN (year)				
<10	-	18 (6.1)	96 (32.8)	179 (61.1)
⩾ 10	-	4 (4.6)	21 (24.1)	62 (71.3)
Number of OCCS¥				
0	840 (96.2)	2 (0.2)	9 (1)	22 (2.5)
1	1353 (94.5)	5 (0.3)	21 (1.5)	52 (3.6)
2	1214 (93.5)	2 (0.2)	24 (1.8)	59 (4.5)
3 or more	2126 (92)	14 (0.6)	63 (2.7)	108 (4.7)
Depression				
No	5166 (93.7)	22 (0.4)	101 (1.8)	224 (4.1)
Yes	374 (91.7)	16 (0.2)	16 (3.9)	17 (4.2)
Employment Status				
Official	2740 (92.1)	10 (0.4)	72 (2.7)	131 (4.9)
Treaty	318 (96.4)	1 (0.3)	4 (1.2)	7 (2.1)
Contractual or Corporate	2745 (94.7)	12 (0.4)	40 (1.4)	103 (3.6)
High-risk behaviors				
Current or Ex-Smoker				
No	4979 (93.5)	20 (0.4)	105 (2)	219 (4.1)
Yes	560 (94)	3 (0.5)	12 (2)	21 (3.5)
Alcoholuser				
No	5258 (93.7)	23 (0.4)	112 (2)	221 (3.9)
Yes	281 (92.1)	0 (0)	5 (1.6)	19 (6.2)
Physical activity (METc‡-h/week)				
<10	1822 (92.7)	8 (0.4)	34 (1.7)	101 (5.1)
10-49.9	1123 (93)	4 (0.3)	36 (3)	44 (3.6)
⩾ 50	2599 (94.4)	11 (0.4)	47 (1.7)	96 (3.5)
Obesity†				
No	4569 (95.4)	16 (0.3)	72 (1.5)	132 (2.8)

Yes	964 (85.8)	7 (0.6)	45 (4)	108 (9.6)
Diabetic				
No	5415 (94.4)	19 (0.3)	93 (1.6)	211 (3.7)
Yes	125 (68.3)	4 (2.2)	24 (13.1)	30 (16.4)
Salt intake				
Low	1940 (90.4)	8 (0.4)	60 (2.8)	139 (6.5)
Medium	3320 (95.4)	14 (0.4)	52 (1.5)	94 (2.7)
High	269 (95.4)	1 (0.4)	5 (1.8)	7 (2.5)

Notes: Data are reported as n (%). HTN: Hypertension. * Defined asHealth workers who were diagnosed with HTN but were not on-treatment. **Defined assystolicblood pressure<130 mm Hg and diastolicblood pressure<80 mm Hg in on-treatment Hypertensive patients. ***Defined assystolicblood pressure ⩾ 130 mm Hg and/or diastolic blood pressure ⩾ 80 mm Hg in on-treatment Hypertensive patients. ¥Ongoing Cumulative Chronic Stressors. ǂ Metabolic equivalents. † Body mass index ⩾ 30 kgm^{-2}.

The prevalence of uncontrolled HTN in men was more than twice that of women (5.6 vs 2.9), and in those over 50 years old, it was almost four times that of those under 50 years old (11.5 vs 2.9), According to Table 1, the prevalence of uncontrolled HTN was higher in individuals exposed to a higher number of ongoing chronic stressors compared to those exposed to fewer of these factors.

In health workers with less than ten hours of physical activity per week (5.1), the prevalence of uncontrolled HTN was higher compared to those with 10-49 hours (3.6) and over 50 (3.5) hours of physical activity in a week.

The prevalence of uncontrolled blood pressure in diabetic health workers is more than 4 times that of non-diabetic health workers (16.4 vs 3.7), in obese workers it is more than 3 times that of non-obese workers (9.6 vs 2.8), and in alcoholic health workers it is more than 1.5 times that of non-alcoholic workers (6.2 vs 3.9).

The results of multivariate regression on uncontrolled blood pressure indicated that male sex (OR = 3.05, 95% CI: 1.84 – 5.06), Duration of HTN(OR = 1.90, 95% CI: 1.03 – 3.48), physical activity (OR = 0.35, 95% CI: 0.18 – 0.66) and diabetes (OR = 0.51, 95% CI: 0.27 – 0.97) were factors associated with uncontrolled blood pressure (Table 2).

Table 2. Factors associated to uncontrolled Hypertension in baseline data of EHWC cohort study of SUMS (reference group = Controlled Hypertension).

Variable	OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Age (Ref = <50)	1.16 (0.73 – 1.85)	0.51	-	-
Male Sex (Ref = Female)	3.02 (1.90 – 4.79)	<0.01	3.05 (1.84 – 5.06)	<0.01
Marital status (Ref = Single)				
Married	1.18 (0.54 – 2.54)	0.67	0.82 (0.35 – 1.88)	0.64
Divorced or widow	0.34 (0.11 – 1.10)	0.07	0.30 (0.08 – 1.04)	0.05
Education (Ref = Illiterate or elementary)				
Middle	0.63 (0.15 - 2.56)	0.52		
High and diploma	0.52 (0.16 – 1.74)	0.29	-	-
College	0.43 (0.14 – 1.33)	0.14		
Family history of HTN(Ref = No)	0.97 (0.62 – 1.52)	0.90	-	-
Duration of HTN (Ref = <10)	1.58 (0.91 – 2.75)	0.10	1.90 (1.03 – 3.48)	0.03
Number of OCCS* (Ref = 0)				
1	(0.4 – 2.55)	0.97		
2	(0.4 – 2.41)	0.99	-	-
3 or more	0.70 (0.30 – 1.61)	0.40		
Depression (Ref = No)	2.09 (1.01 – 4.29)	0.04	1.73 (0.79 – 3.78)	0.16
Employment Status (Ref = Official)				
Treaty	0.96 (0.27 – 3.39)	0.95	-	-
Contractual or Corporate	1.41 (0.88 – 2.25)	0.14		
Current or Ex-Smoker (Ref = No)	0.83 (0.39 – 1.77)	0.64	-	-
Alcoholuser (Ref = No)	1.92 (0.7 – 5.29)	0.20	-	-
Physical activity (METc‡-h/week) (Ref = <10)				
10-49.9	0.41 (0.22 – 0.74)	<0.01	0.35 (0.18 – 0.66)	<0.01
⩾ 50	0.68 (0.40 – 1.15)	0.16	0.58 (0.33 – 1.02)	0.05
Obesity‡ (Ref = No)	1.30 (0.83 – 2.05)	0.24	-	-
Diabetic (Ref = No)	0.55 (0.30 – 0.99)	0.04	0.51 (0.27 - 0.97)	0.04
Salt intake (Ref = Low)				
Medium	0.78 (0.49 – 1.22)	0.28	-	-
High	0.60 (0.18 – 1.98)	0.40		

Notes: Values are reported as odds ratio and 95% confidence interval. Logistic regression analysis was used to determine the association. Statistical significance was set at the level of P<0.05. Bolded values indicate that the p-value is < 0.05. Variables with p-values under 0.2 in the crude model were included in the adjusted model.

Discussion

Out of 5925 healthcare workers aged 20 to 74 years recruited in the cohort, 381 (6.43%) health workers were diagnosed with HTN. Of these, 93% (358 cases) declared that they are on-treatment. HTN was controlled in only 33% of the on-treatment patients and antihypertensive regimes failed in 67%. Similarly, in a study of near 4400 people aged 50–74 who participated in Shahrud, northern Iran, a 61.7% prevalence of uncontrolled HTN was reported. It should be noted that in that study, the definition was slightly different compared to our survey. Farhadi et. al. considered HTN uncontrolled if SBP ⩾ 140 mmHg or DBP ⩾ 90 mmHg in those on antihypertensive medicines and those who do not treat while suffering from diabetes and chronic kidney disease (Farhadi et al., 2023). Moreover, in another study on 2320 adults aged 40–80 years in Yazd, central Iran, 68.5% of uncontrolled blood pressure (⩾ 140/90 mmHg) were reported (Katibeh et al., 2020). Lesser found prevalence of uncontrolled HTN in our study may come from the younger studied population in SUMS EHCS.

In this survey, the prevalence of uncontrolled HTN was more than twice in men. Male sex with an adjusted OR of 3.05 was the strongest predictor of uncontrolled HTN. Likewise, in two other cohort studies in Iran, male gender (OR = 2.1, 2.38) was associated with uncontrolled HTN (Farhadi et al., 2023; Khosravi et al., 2014). Despite this remarkable difference among genders in the Iranian population, it seems that not a global consistency over this issue. Previous reports from reports Russia and Mexico are compatible with our findings (Petersen et al., 2020; Palomo-Piñón et al., 2022), studies on South African and Somalian populations reported an insignificant relation (Masilela et al., 2020; Mohamud et al., 2024) and an Italian study mentioned an opposing relation (female predominancy) (Romano et al., 2023).

Uncontrolled HTN was almost four times more common in those over 50 years old compared to younger individuals under 50 years old (17.13%), although age did not emerge as a contributing factor to uncontrolled HTN when compared to controlled HTN, Romano et. al. did not find any significant difference in age among controlled and uncontrolled HTN in a survey of more than 200000 Italian adult urban residents (Romano et al., 2023), however, uncontrolled HTN was significantly more prevalent in the elderly population (> 60 years) compared to younger counterparts (62.5% versus 60.9%) in a previous study (Farhadi et al., 2023). This is a key point for stakeholders, that elderly hypertensive patients are usually being treated with less aggressive hypertensive regimens despite less controlled blood pressure and more adverse sequelae they are prone to experience (Borzecki et al., 2006;Sakboonyarat et al., 2019).

Uncontrolled HTN was considerably more frequent in those whose disease had been diagnosed more than 10 years ago (71.3% versus 61.1). This factor with adjusted OR of 1.90 was a notable predictor of blood pressure controllability. Our findings are consistent with previous studies in which duration of HTN was found to be an independent predictor of masked uncontrolled HTN. This may be due to medication non-adherence, which usually develops over time and has been found to be a major predictor of uncontrolled HTN (Naser et al., 2016; Gebremichael et al., 2019; Shi et al., 2020).

Ten to 49 hours of weekly physical activity is found to be an independent protective factor for uncontrolled HTN (OR = 0.58). This is in line with a previous study in which physical inactivity was reported as a risk factor for uncontrolled HTN (OR = 1.931, 3.20) in one of them (Gebremichael et al., 2019; Abdisa et al., 2022), however, this is not acknowledged in most previous studies in Iran (Arabzadeh et al., 2014; Katibeh et al., 2020; Farhadi et al., 2023). Moreover, it should be noted that irregular physical activity was linked with uncontrolled HTN in some of the previous studies (Araújo et al., 2022).

Though depression is significantly more prevalent in those with uncontrolled HTN (unadjusted OR = 2.09, P = 0.04), this relation was not persistent when Confounding factors were considered (adjusted OR = 1.73. P = 0.160) in our study. Previous studies set an association between these two even after adjusting for age and gender, education, and clinical characteristics (Almas et al., 2014; Wang et al., 2021).

Interestingly, diabetes mellitus found to a protective factor for uncontrolled HTN with adjusted OR of 0.51 in our study. However, our findings is not compatible with previous investigations in which diabetes was more prevalent in those with uncontrolled HTN (Khosravi et al., 2014; Farhadi et al., 2023; Romano et al., 2023), higher overall HTN control was reported in an study focusing of uncontrolled HTN in Iranian diabetic patients. In Rabizadeh's study, 56.8% of diabetic participants' HTN were uncontrolled which is lesser than our figures (67%) (Rabizadeh et al., 2021).

Many other eye-catching different distributions among studied features were detected in the survey, although they were not statistically significant. Giving an instance, obese participants were 3 times more

common in the group with low blood pressure control. Eventually, we cannot conclude any statistically remarkable association between, high-risk behavior (smoking, alcohol consumption), level of education, family history of HTN, marital status, salt intake, and employment status. There is not any definite consensus regarding these issues in the literature. In parallel with our findings, in a study on more than 18000 adult Indian residents, not any remarkable differences were found between controlled and uncontrolled HTN groups in terms of marital and occupational status, and education level (Kanungo et al., 2017). Likewise, in the Isfahan cohort study of more than 6500 participants, neither marital status and education level, nor smoking habits differs among groups (Khosravi et al., 2014). The limitations of our study should be taken into consideration when interpreting the results.

First, the cross - sectional design of this study limits causal inferences on risk factors for uncontrolled HTN.Second, the study population includes health workers who may not be fully representative of the general population due to higher health literacy and better access to health care. Therefore, our estimates of the prevalence of uncontrolled HTN may be underestimated compared to the general population.

Conclusion

This study among health workers in southern Iran revealed that a significant number of health workers with HTN were not able to control their condition despite on-treatment. Factors such as sex, time since diagnosis, physical activity, and diabetes were found to be associated with the prevalence of uncontrolled HTN among the participants. These findings highlight the importance of targeted interventions to address modifiable risk factors and enhance HTN management among healthcare workers, promoting their well-being and decreasing associated complications.

Acknowledgements

All authors listed meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship. They take full responsibility for the integrity of the work as a whole and have given their approval for this version to be published. Shiraz University of Medical Sciences financially supported this study (code: 26483).

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