



## Prevalence of pre-hypertension and hypertension, awareness, treatment, and control of hypertension, and cardiovascular risk factors in postmenopausal women

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### Original Article

#### Abstract

**BACKGROUND:** Pre-hypertension (HTN) and HTN are risk factors for cardiovascular disease (CVD). Despite its importance, HTN is often underestimated and undiagnosed, especially in women. This study was designed to determine the prevalence of pre-HTN and HTN among a large sample of Iranian menopausal women.

**METHODS:** This repeated cross-sectional study was conducted on 1013 menopausal women aged 41 to 85 years in Isfahan, Iran, in the years 2001, 2007, and 2016. The participants were selected through multistage cluster random sampling. Awareness, treatment, and control of HTN were assessed using a validated researcher-made questionnaire. Blood pressure was determined via an arm digital blood pressure monitor.

**RESULTS:** The prevalence of HTN in the years 2001, 2007, and 2016 was 52.6%, 49.0%, and 51.6%, respectively; no significant changes were observed ( $P > 0.05$ ). The prevalence of pre-HTN in these years was 56.6%, 53.3%, and 42.2%, respectively. In 2001 and 2007, respectively, 28.8% and 50.4% of menopausal women had HTN controlled by medication, and in 2016, 86.6% of women were aware of their disease and 62% of them had controlled HTN ( $P < 0.001$ ).

**CONCLUSION:** The results showed that HTN and pre-HTN were highly prevalent among Iranian menopausal women and markedly increased with age. Interventional population-based approaches are needed to improve knowledge and efficient practice that may help to lower the risk of HTN and CVD in this at-risk population.

**Keywords:** Blood Pressure; Epidemiology; Pre-hypertension; Hypertension; Risk Factors; Menopause; Women

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#### Introduction

Hypertension (HTN) is a major risk factor for cardiovascular diseases (CVDs). According to the World Health Organization (WHO), 1 out of every 3 adults in the world had high blood pressure in 2012 and it is predicted that this number will increase to more than 1.56 billion by the year 2025.<sup>1</sup> In addition to HTN, pre-HTN is also recognized as an important risk factor for CVDs.<sup>2,3</sup> In recent years, several studies have reported the increased risk of CVDs in people with pre-HTN.<sup>4,6</sup> Before

menopause, the prevalence of HTN in women is much lower than in men; however, its prevalence increases significantly in postmenopausal women

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and equates to that in men.<sup>5</sup> Postmenopausal women are at increased risk of HTN and around 50% suffer from high blood pressure.<sup>7</sup> Recent studies have showed that 25% of women worldwide and more than 75% of women over the age of 60 in the United States have HTN.<sup>4</sup> In a 3-year study among 4,680 menopausal Spanish women, 27.3% of those who had normal blood pressure before menopause were pre-hypertensive in the postmenopausal period. This finding confirms the increase in pre-HTN in the postmenopausal period.<sup>8</sup> With the growth in the world's older population, about 25 million women reach menopause every year, and with an increase of 47 million new cases annually, this figure is predicted to reach 1.2 billion in 2025.<sup>9</sup> Menopause is a normal, natural event, defined as the final menstrual period and usually occurs at the age of 45-55 years. Postmenopausal has been defined as not having experienced a period for 12 months or more.<sup>10</sup>

Studies on the causes of HTN in postmenopausal women indicate that a combination of factors such as the reduced vasodilator effect of endogenous estrogens, increased arterial sclerosis, increased salt sensitivity, decreased production of endothelial vascular nitric oxide, and increased receptor responses to angiotensin II may contribute to the increase in systolic blood pressure (SBP).<sup>11</sup> Furthermore, postmenopausal women are more predisposed to other cardiovascular risk factors such as dyslipidemia, diabetes mellitus (DM), and obesity.<sup>5</sup> HTN is usually asymptomatic, but can be detected without needing advanced diagnostic equipment and can be easily treated and controlled with adherence to healthy lifestyle and medication recommendations.<sup>12</sup> According to the WHO, less than 50% of people with HTN are aware of their condition, 25% receive treatment, and less than 12.5% of these individuals manage the disease effectively.<sup>13</sup> Awareness of HTN is defined as a prior diagnosis of HTN by a physician, and lack of awareness of high blood pressure is defined as blood pressure of 140/90 mmHg without prior diagnosis by a physician or the use of antihypertensive drugs.<sup>14</sup>

Although the global prevalence of HTN is estimated to be about 22% in the adult population, this prevalence differs among countries and age groups.<sup>1</sup> While the prevalence of HTN is declining in higher income countries, lower income countries are encountering an increasing number of patients with HTN.<sup>15</sup> Since demographic and social changes in these societies contribute to this issue, improving

lifestyle and increasing the awareness of patients about the disease can help healthcare systems overcome the problem.<sup>1</sup>

In addition, developing countries encounter a growing number in their aging population. Even though the prevalence of HTN increases with age, adequate treatment is infrequent in older patients.<sup>16</sup> Consequently, identifying the pattern of disease prevalence and risk factors is essential for devising a targeted screening program and promoting the awareness of people about the modifiable risk factors of HTN.

Regarding these facts, we devised a cross-sectional study focused only on the post-menopausal women population to determine the prevalence of pre-HTN, HTN, and awareness, treatment, and management of HTN, and risk factors for CVDs among postmenopausal women in Isfahan, the largest city in central Iran.

## Materials and Methods

In this repeated cross-sectional study, the data from 3 independent samples in 2001, 2007, and 2016 were used to determine the prevalence of HTN and pre-HTN, and awareness, treatment, and management of HTN in menopausal women in Isfahan. In 2001, 2007, and 2016, respectively, 3703, 2660, and 2107 adult residents of Isfahan were interviewed; however, only 397, 298, and 318 of these individuals were menopausal women, respectively. Multistage cluster random sampling was used for the selection of the study participants. The details regarding sample size calculation have been previously presented.<sup>17</sup>

The inclusion criteria were over 40 years of age, lack of menstruation for at least 12 months,<sup>10,11</sup> and confirmation of being menopausal by a physician. The exclusion criteria included fasting or having a diet either for obesity or for weight loss at the time of the study, and having known comorbidities such as kidney failure and cancer. Methods for the sample size estimation and sampling, the procedures for measuring the blood pressure, height, and weight, and data collection methods of the 3 cross-sectional studies have been fully described in the earlier published articles.<sup>17-19</sup>

**Definitions:** In the Seventh Report of the Joint National Committee (JNC-7), HTN was defined as a SBP  $\geq 140$  mmHg, and/or diastolic blood pressure (DBP)  $\geq 90$  mmHg, and/or use of antihypertensive medications.<sup>20</sup> Pre-HTN was defined as not being on antihypertensive drugs, and having an SBP of 120-139 mmHg and/or DBP of

80-89 mmHg.<sup>21</sup> Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared ( $\text{kg}/\text{m}^2$ ). DM was considered as plasma glucose level  $\geq 126$  mg/dl if the participant had fasted or  $\geq 200$  mg/dl if the participant had not fasted.<sup>22</sup>

“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.” “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  $< 140$  mmHg and DBP  $< 90$  mmHg.”<sup>23</sup>

**Data collection, variables, and tools:** The data collected using the questionnaire included demographic characteristics and clinical information. A validated and reliable researcher-developed questionnaire was utilized in this study.<sup>14</sup> At the health center, the candidates were first asked to sign a written consent form, and then, while seated in a chair, they answered questions about their demographic details, including age, gender, years of education, marital status, economic status, occupation, and history of DM and elevated blood lipids. They then relaxed in a quiet environment for 5 minutes. The WHO standards for taking blood pressure were met,<sup>24</sup> and BP in the right arm in a seated position was measured and recorded 3 times at 1-minute intervals. The mean of the second and third measurements was considered as the subject’s blood pressure. If the mean SBP was  $\geq 140$  mmHg and/or the mean DBP was  $\geq 90$  mmHg, or if the subject reported having been diagnosed with HTN and taking antihypertensive medications, he or she was considered a case of HTN. If the subject reported having been diagnosed with HTN by a health professional or taking medication for high blood pressure, he or she was considered to be a case of HTN who was aware of the disease.<sup>25</sup> The subjects’ height was measured in centimeters in a standing position using a non-elastic measuring tape mounted on the wall and calibrated with a metal measuring tape. Their weight was measured in kilograms wearing light-weight clothing and without shoes using a digital scale (Soehnle, Nassau, Germany). The prevalence of awareness, pharmacological treatment, and control of HTN was determined according to definitions presented

by Afsargharehbagh et al.<sup>23</sup>

According to this reference, the proportion of adults with HTN was considered based on (1) drug use for blood pressure and (2) SBP pressure displayed on the instrument monitor screen.

Third, the instrument used to measure BP was the same for all participants.

**Statistical analysis:** Data was presented as mean  $\pm$  standard deviation for continuous variables and frequency (percentage) for categorical variables. The normality of continuous data was evaluated using Kolmogorov-Smirnov (K-S) test. One-way analysis of variance (ANOVA) was used for comparing continuous, normally distributed data between 3 time points and Bonferroni post hoc test was used for pairwise comparisons. Chi-square test was used for comparing the prevalence of pre-HTN and HTN risk factors between study time points. Univariate and multiple binary logistic regressions were used to evaluate the risk factors of pre-HTN and HTN. SPSS software (version 18.0, SPSS Inc., Chicago, IL, USA) was used for data analysis. Moreover, all p-values of less than 0.05 were considered to be statistically significant.

## Results

A total of 1013 menopausal women of older than 40 years participated in this study. The minimum and maximum menopausal ages in the years 2001, 2007, and 2016 were 27 and 67, 29 and 60, and 28 and 65 years, respectively. Moreover, the mean age of menopause was  $46.95 \pm 5.63$ ,  $47.06 \pm 5.62$ , and  $48.31 \pm 6.26$  years in 2001, 2007, and 2016 ( $P = 0.006$ ), respectively. The mean and SD of BMI of the participants for the respective years was also  $28.80 \pm 5.07$ ,  $28.65 \pm 4.41$ , and  $29.93 \pm 4.62$  ( $P = 0.001$ ). Furthermore, the mean SBP of the participants in the respective years was  $131.22 \pm 22.63$ ,  $124.09 \pm 20.59$ , and  $126.64 \pm 19.32$  mmHg ( $P = 0.001$ ), while their mean DBP was  $81.87 \pm 13.93$ ,  $77.23 \pm 11.66$ , and  $74.24 \pm 10$  mmHg ( $P = 0.001$ ), respectively. The demographic and clinical characteristics of the participants for the 3 respective years are presented in table 1. The prevalence of DM was 15.9%, 15.8%, and 27% in 2001, 2007, and 2016 ( $P = 0.001$ ), while the prevalence of hyperlipidemia was 29.2%, 35.6%, and 49.4% in the same years ( $P = 0.001$ ), respectively. Moreover, the prevalence of positive family history of HTN among the participants in the 3 respective years was 31.2%, 51.7%, and 66.7% ( $P = 0.001$ ).

**Table 1.** Demographic characteristics, clinical information, and cardiovascular risk factors in postmenopausal women in 2001, 2007, and 2016

| Variable   | 2001 (n = 397) | 2007 (n = 298) | 2016 (n = 318) | P       |
|--|----------------|----------------|----------------|---------|
|  | Mean ± SD      | Mean ± SD      | Mean ± SD      |         |
| Age (year)   | 59.86 ± 8.77   | 61.15 ± 9.49   | 60.53 ± 8.34   | 0.165*  |
| Age at Menstrual cessation (year)                        | 46.95 ± 5.63   | 47.06 ± 5.61   | 48.28 ± 6.17   | 0.006*  |
| Body mass index (kg/m <sup>2</sup> )                     | 28.80 ± 5.07   | 28.65 ± 4.41   | 29.93 ± 4.62   | 0.001*  |
| Systolic blood pressure (mm/Hg)                          | 131.22 ± 22.63 | 124.09 ± 20.59 | 126.64 ± 19.32 | 0.001*  |
| Diastolic blood pressure (mm/Hg)                         | 81.87 ± 13.93  | 77.23 ± 11.66  | 74.24 ± 10.83  | 0.001*  |
| Years of education                                       |                |                |                | 0.001** |
| 0-5  | 339 (85.6)     | 215 (72.1)     | 204 (64.2)     |         |
| 6-12   | 48 (12.1)      | 71 (23.8)      | 92 (28.9)      |         |
| > 12   | 9 (2.3)        | 12 (4)         | 22 (6.9)       |         |
| Occupation   |                |                |                | 0.002** |
| Employed   | 12 (3)         | 7 (2.3)        | 14 (4.4)       |         |
| Retired  | 4 (1)          | 17 (5.7)       | 19 (6)         |         |
| Homemaker  | 381 (96)       | 247 (91.9)     | 285 (89.5)     |         |
| Marital status   |                |                |                | 0.052** |
| Single/divorced/widowed                                  | 126 (31.8)     | 39 (23.1)      | 81 (25.5)      |         |
| Married  | 270 (68.2)     | 130 (76.9)     | 237 (74.5)     |         |
| Smoking  | 14 (3.5)       | 5 (1.7)        | 6 (1.9)        | 0.217** |
| Diabetes   | 63 (15.9)      | 47 (15.8)      | 86 (27)        | 0.001** |
| Hyperlipidemia   | 116 (29.2)     | 106 (35.6)     | 157 (49.4)     | 0.001** |
| Family history of hypertension (In 1st-degree relatives) | 124 (31.2)     | 154 (51.7)     | 212 (66.7)     | 0.001** |
| General health questionnaire (psychological distress)    |                |                |                | 0.721** |
| 0-3 (low stress)   | No data        | 177 (59.6)     | 185 (58.2)     |         |
| ≥ 4 (high stress)  | No data        | 120 (40.4)     | 133 (41.1)     |         |
| Add salt to food when eating                             |                |                |                | 0.001** |
| Never  | 253 (63.7)     | 197 (66.1)     | 257 (69.8)     |         |
| Sometimes  | 101 (25.5)     | 81 (27.2)      | 58 (23.7)      |         |
| Always   | 43 (10.8)      | 20 (6.7)       | 3 (6.5)        |         |

Data was presented as mean ± standard deviation for continuous variables and frequency (percentage) for categorical variables. P-values were derived from \*one-way ANOVA for continuous variables and \*\*chi-square test for categorical variables as appropriate.

As presented in table 2, the prevalence of HTN in menopausal women was 52.6%, 49.0%, and 51.6% in 2001, 2007, and 2016. In addition, the prevalence of pre-HTN was 59.6%, 53.3%, and 42.2%, respectively. Comparison of the prevalence of pre-HTN and HTN in postmenopausal women in the age categories studied in 2001, 2007, and 2016 showed a significant difference. Furthermore, during the respective years, the highest prevalence was observed among women over the age of

70 years.

Table 3 shows that the prevalence of HTN awareness among the menopausal women was 74.6% in 2001, 77.4% in 2007, and 86.6% in 2016. Accordingly, the prevalence of well-controlled HTN was 28.8% in 2001, 50.4% in 2007, and 62.0% in 2016. Moreover, in 2001, 73.7% of menopausal women who were undergoing medical treatment for HTN used their medications regularly. This rate was 71.9% in 2007 and 86.6% in 2016.

**Table 2.** Prevalence of hypertension and pre-hypertension in age categories among menopausal women in 2001, 2007, and 2016

| Year              | 2001 [n (%)] |            | 2007 [n (%)] |            | 2016 [n (%)] |            |
|-------------------|--------------|------------|--------------|------------|--------------|------------|
|                   | Pre-HTN      | HTN        | Pre-HTN      | HTN        | Pre-HTN      | HTN        |
| Age group (years) |              |            |              |            |              |            |
| Total             | 112 (59.6)   | 209 (52.6) | 81 (53.3)    | 146 (49.0) | 65 (42.2)    | 164 (51.6) |
| < 60              | 66 (55.9)    | 80 (40.4)  | 44 (47.3)    | 46 (33.1)  | 33 (31.4)    | 59 (36.0)  |
| 60-70             | 31 (62.0)    | 88 (63.8)  | 22 (57.9)    | 56 (59.6)  | 25 (67.9)    | 60 (61.9)  |
| > 70              | 15 (75.0)    | 41 (67.2)  | 15 (71.4)    | 44 (67.7)  | 7 (58.3)     | 45 (78.9)  |
| P                 | 0.253*       | < 0.001**  | 0.109*       | < 0.001**  | < 0.001*     | < 0.001**  |

HTN: Hypertension; Data was presented as frequency (percentage).

\* P-values represent the comparisons between age categories in pre-hypertension from chi-square tests.

\*\* P-values represent the comparisons between age categories in hypertension from chi-square tests.

**Table 3.** The process of awareness, treatment, and control of hypertension in menopausal women with hypertension

| Year                      |               | 2001 [n (%)] | 2007 [n (%)] | 2016 [n (%)] | P*                                     |
|---------------------------|---------------|--------------|--------------|--------------|--|
| Awareness                 | Yes           | 156 (74.6)   | 113 (77.4)   | 142 (86.6)   | 0.015 <sup>**</sup> , <sup>***</sup>   |
|                           | No            | 53 (25.4)    | 33 (22.6)    | 22 (13.4)    |  |
| Pharmacological treatment | Regular use   | 154 (73.7)   | 105 (71.9)   | 142 (86.6)   | 0.009 <sup>***</sup> , <sup>£</sup>    |
|                           | Irregular use | 42 (20.1)    | 33 (22.6)    | 20 (12.2)    |  |
|                           | No            | 13 (6.2)     | 8 (5.5)      | 2 (1.2)      |  |
| HTN control               | Yes           | 45 (28.8)    | 57 (50.4)    | 88 (62.0)    | < 0.001 <sup>**</sup> , <sup>***</sup> |
|                           | No            | 111 (71.2)   | 56 (49.6)    | 54 (38.0)    |  |

HTN: Hypertension; Data was presented as frequency (percentage) for categorical variables.

\* P-values were derived from chi-square test and adjusted Bonferroni for categorical variables as appropriate.

<sup>\*\*</sup> significant difference between 2001 and 2007, <sup>\*\*\*</sup> significant difference between 2007 and 2016, <sup>£</sup> significant difference between 2001 and 2016

Table 4 illustrates the prevalence of cardiovascular risk factors among hypertensive menopausal women in the 3 respective years. The prevalence of DM in menopausal women was 19.6% in 2001, and increased to 21.9% and 34.8% in 2007 and 2016 (P = 0.002), respectively. Moreover, the prevalence of hyperlipidemia was 34.4% in 2001, and increased to 43.6% and 57.9% in 2007 and 2016, respectively. The prevalence of positive family history of HTN was 39.2% in 2001 and increased to 53.4% and 68.5% in 2007 and 2016 (P < 0.001), respectively.

Logistic regression results (Table 5) showed that during 2001, 2007, and 2016, the presence of cardiac risk factors (age, increased BMI, DM, hyperlipidemia, and family history of HTN) increased the risk of developing HTN in menopausal women. In 2016, every 1 year increase in age significantly increased the risk of HTN by 12.5% [OR = 1.125 (1.086-1.167)]. In the same year, being diabetic increased the risk HTN among postmenopausal women by 84.8% [OR = 1.848 (1.014-3.367)].

## Discussion

Age at menopause in our studied sample was similar to previous estimates reported for other Iranian populations. In a cross-sectional study on 960 menopausal women in Isfahan in 2015, mean and median of natural menopause age were 48.66 and 48 years, respectively.<sup>25</sup> In the present study, the

mean age at permanent cessation of menstrual periods has significantly increased and reached 48 years of age in 2016. It seems that a combination of factors such as genetics, ethnicity, smoking behavior, socioeconomic status, and fertility history may affect the age of menopause. The present study showed a significant increase in both BMI and the risk of HTN in postmenopausal women. An earlier study also showed that the mean BMI of women was 22.1 kg/m<sup>2</sup> in 1975 and increased to 24.4 in 2014.<sup>26</sup> There is also more evidence of the increasing trend of BMI in many societies and its direct association with the incidence of pre-HTN and HTN.<sup>27</sup> In this regard, a study reported that compared to those with a BMI < 25 the risk of HTN would, respectively, be increased by 67% and 150% in subjects with a BMI of 25-30 and a BMI > 30.<sup>28</sup> Another study on the prevalence of cardiovascular risk factors in Russian patients with HTN also reported hypertriglyceridemia, hyperglycemia, and obesity as the major risk factors associated with hypertension.<sup>29</sup>

The present study showed that the mean SBP and DBP of postmenopausal women were significantly lower in 2016 than in 2001. In line with this finding, a study on the prevalence of HTN in the adult population of the United States showed that from 1999 to 2010 mean SBP and DBP decreased both in men and women, and this decline was greater in women.<sup>30</sup>

**Table 4.** Cardiovascular risk factors in postmenopausal women with hypertension

| Year   | 2001 [n (%)] | 2007 [n (%)] | 2016 [n (%)] | P  |
|--|--------------|--------------|--------------|--|
| Age (years)  | 61.97 (8.55) | 63.99 (8.74) | 63.53 (8.15) | 0.058 <sup>*</sup>   |
| BMI (kg/m <sup>2</sup> )   | 29.45 (5.12) | 29.09 (4.43) | 30.38 (4.79) | 0.051 <sup>*</sup>   |
| Diabetes (Yes)   | 41 (19.6)    | 32 (21.9)    | 57 (34.8)    | 0.002 <sup>**</sup> , <sup>£</sup> , <sup>‡</sup> , <sup>£</sup>   |
| Hyperlipidemia   | 72 (34.4)    | 64 (43.8)    | 95 (57.9)    | < 0.001 <sup>**</sup> , <sup>‡</sup> , <sup>£</sup> , <sup>‡</sup> |
| Family history of hypertension (In first-degree relatives) (Yes) | 81 (38.8)    | 79 (54.1)    | 116 (70.7)   | < 0.001 <sup>**</sup> , <sup>‡</sup> , <sup>£</sup>                |

BMI: Body mass index; P-values were derived from\* One-way ANOVA for continuous variables and \*\*chi-square test, post hoc test, and Bonferroni test, adjusted for categorical variables as appropriate.

<sup>£</sup> significant difference between 2001 and 2007, <sup>‡</sup> significant difference between 2007 and 2016, <sup>£</sup> significant difference between 2001 and 2016

**Table 5.** Association between hypertension and cardiovascular risk factors in menopausal women

| Variables                            | 2001                 |       | 2007                 |       | 2016                 |       |
|--------------------------------------|----------------------|-------|----------------------|-------|----------------------|-------|
|                                      | OR (95% CI)          | P     | OR (95% CI)          | P     | OR (95% CI)          | P     |
| Age (year)                           |                      |       |                      |       |                      |       |
| Crud                                 | 1.063 (1.037, 1.089) | 0.001 | 1.069 (1.041, 1.098) | 0.001 | 1.109 (1.074, 1.146) | 0.001 |
| Adjusted*                            | 1.077 (1.049, 1.106) | 0.001 | 1.070 (1.040, 1.101) | 0.001 | 1.125 (1.086, 1.167) | 0.001 |
| Body mass index (kg/m <sup>2</sup> ) |                      |       |                      |       |                      |       |
| Crud                                 | 1.056 (1.014, 1.100) | 0.009 | 1.046 (0.992, 1.104) | 0.095 | 1.045 (0.996, 1.097) | 0.073 |
| Adjusted**                           | 1.067 (1.020, 1.117) | 0.005 | 1.060 (1.001, 1.122) | 0.048 | 1.059 (1.002, 1.119) | 0.044 |
| Diabetes                             |                      |       |                      |       |                      |       |
| Crud                                 | 1.841 (1.051, 3.226) | 0.033 | 2.545 (1.313, 4.933) | 0.006 | 2.296 (1.370, 3.848) | 0.002 |
| Adjusted***                          | 1.518 (0.815, 2.829) | 0.188 | 1.938 (0.950, 3.956) | 0.069 | 1.848 (1.014, 3.367) | 0.045 |
| Hyperlipidemia                       |                      |       |                      |       |                      |       |
| Crud                                 | 1.720 (1.105, 2.676) | 0.016 | 2.044 (1.261, 3.313) | 0.004 | 2.043 (1.307, 3.195) | 0.002 |
| Adjusted****                         | 1.337 (0.815, 2.191) | 0.250 | 1.453 (0.847, 2.493) | 0.175 | 1.450 (0.860, 2.444) | 0.163 |
| Family history of hypertension       |                      |       |                      |       |                      |       |
| Crud                                 | 2.134 (1.375, 3.312) | 0.001 | 1.211 (0.768, 1.908) | 0.411 | 1.460 (0.914, 2.332) | 0.113 |
| Adjusted*****                        | 2.433 (1.501, 3.943) | 0.001 | 1.520 (0.909, 2.541) | 0.110 | 2.534 (1.434, 4.476) | 0.001 |

P-values were derived from Logistic regression. Adjusted\* with BMI, Diabetes, Hyperlipidemia, and Family history of hypertension; Adjusted\*\* with Age, Diabetes, Hyperlipidemia, and Family history of hypertension; Adjusted\*\*\* with Age, BMI, Hyperlipidemia, and Family history of hypertension; Adjusted\*\*\*\* with Age, BMI, Diabetes, and Family history of hypertension; Adjusted\*\*\*\*\* with Age, BMI, Diabetes, and Hyperlipidemia  
OR: Odds ratio; CI: Confidence interval

Several studies in Central and Eastern Europe, Latin America and the Caribbean area, Central Asia, the Middle East and North Africa have also confirmed a slight decline in mean blood pressure among women during the recent decades.<sup>31</sup>

The present study showed an increasing trend in the prevalence of DM and hyperlipidemia in postmenopausal women from 2001 to 2016. Moreover, in 2016, the risk of HTN was higher in diabetic patients than non-diabetic individuals. Studies on the global incidence of DM have also shown that the incidence of DM in women has increased from 5% in 1980 to 7.9% in 2014.<sup>25</sup> The prevalence of hyperlipidemia has also increased in China.<sup>27</sup> It has also been shown that the chances of developing CVDs will, respectively, increase up to 107% and 48% in postmenopausal women with DM and hyperlipidemia.<sup>28</sup>

The results of this study revealed an increase in the positive family history of HTN in postmenopausal women from 2001 to 2016, and in 2016 nearly two-thirds of postmenopausal women had a positive family history of HTN in one of their first-degree relatives (i.e., parents and siblings). Moreover, as presented in the current study, in 2001 and 2016 the chance of having HTN was higher in women with a positive family history of HTN than those without a family history. In line with this finding, Zhou et al. have also reported that

the risk of CVD will be increased by 56% in postmenopausal women with a positive family history of HTN.<sup>28</sup>

The results of the present study showed that salt intake decreased in menopausal women from 2001 to 2016, and over time, a smaller percentage of postmenopausal women used a saltshaker while eating. These results are consistent with 2 earlier studies that investigated the use of salt by Iranian women. The first study was conducted in 2006 and reported that 55% of women in Rasht city, Iran, and 46% of women in Qazvin city, Iran, added salt to their meal.<sup>32</sup> However, the second study conducted in 2011 showed that 13.5% of women referring to healthcare centers in the city of Yazd, Iran, used a saltshaker during their meal.<sup>33</sup> These findings show that the percentage of Iranian women who add table salt to their foods has a decreasing trend.

The results of this study indicated that the prevalence of HTN increased with age, and the highest prevalence was observed in those over 70 years of age. Moreover, the risk of getting HTN increased by 7-12 percent for every year of increase in age. A recent study also found that every 1-year increase in age of postmenopausal women was associated with a 7% increased risk of CVDs.<sup>28</sup>

The present study showed that the prevalence of HTN did not change significantly from 2001 to 2016, but the prevalence of pre-HTN in

postmenopausal women decreased, especially in the age group of 40 to 60 years. In a study in China in 2014, the prevalence of HTN was 43.6%, 62.3%, and 75.5% among postmenopausal women in the age groups of 45-54 years, 55-64 years, and over 65 years.<sup>28</sup> A recent study also showed that the prevalence of HTN among postmenopausal women was 47.1% in Argentina.<sup>34</sup> Studies in Iran also reported that 65.5% and 33.9% of Iranian postmenopausal women were hypertensive in 2008 and 2013, respectively.<sup>13,14,17</sup>

According to the results of this study, the prevalence of HTN awareness, regular use of medications, and well-controlled HTN were constantly increasing from 2001 to 2016. In another study on people with HTN in Isfahan, Iran, the prevalence of awareness of HTN, regular use of medications, and well-controlled HTN were 69.2%, 92.4%, and 59.9%, respectively.<sup>13</sup> Our findings are also consistent with a study on the American adult population in which the prevalence of HTN awareness and well-controlled HTN has been significantly increased between the years 1999 and 2010.<sup>30</sup> Surprisingly, a study in Canada has reported that the prevalence of HTN has not significantly change in the last 2 decades. Although, in 1992, the rates of HTN awareness, and good treatment, and control were 56.9%, 34.6%, and 13.2%, which in 2009 increased to 82.5%, 79.8%, and 64.6%, respectively.<sup>35</sup> In a cross-sectional study on the data of cohort studies published from 2004 to 2008 on 50045 Iranian people aged 40-75 years living in Golestan Province in northeastern Iran (20% living in urban areas and 80% living in rural areas), after adjusting for age, the overall prevalence of HTN was 41.8%.<sup>36</sup> The prevalence of HTN was significantly higher in women than in men (44.1% vs. 33.1%). Of those with HTN, 46.2% were aware of their illness and 17.6% had received antihypertensive drugs. Among those who were undergoing medical treatment, 32.1% could control their disease. The rate of HTN awareness was higher in women, older adults, those who were overweight and obese, and those with higher levels of wealth. High blood pressure was directly associated with female gender, increased BMI, Turkmen ethnicity, and physical inactivity, but it was inversely correlated with black tea drinking and wealth.<sup>36</sup>

The present study showed that the rate of regular medication intake was 73.7% in 2001 and increased to 86.6% in 2016. Moreover, the rates of well controlled HTN and HTN awareness in postmenopausal women have, respectively,

increased from 28% to 62% and 75% to 87% from the first to the third survey. These significant increasing trends might be attributed to a number of factors such as improvements in women's education and employment status, improved attitudes toward health maintenance, and increased accessibility of healthcare and medical facilities in the country. Moreover, as Sabouhi et al. reported, an increase in multimodal and communitywide health promotion and health education programs, free screening projects, community-based health interventions, and increase in the number of healthcare centers might have contributed to this change.<sup>37</sup>

Furthermore, as the present study showed, Iranian women (including postmenopausal women) have become more educated, gained higher levels of financial independence, and increased their community participation during the last 2 decades, which may consequently affect their awareness, and the treatment and control of their blood pressure. A study in the United States examined 10-year trends in the prevalence, treatment, and control of HTN; it showed that the rate of HTN awareness and HTN control in men and women was 69.7% and 80.7%, and 43% and 56%, respectively. These trends also increased from 1999 to 2010.<sup>30</sup>

The limitations of this study have been fully explained in another article.<sup>13</sup> In addition to those explained, the study had other limitations. A limitation was that age at menopause was self-reported and may be subject to recall bias. In addition, this was a cross-sectional study and the findings do not reveal causality, and finally, women with a history of hysterectomy or ovariectomy were not excluded from the study. The strengths of the study include observing the standard conditions for measuring blood pressure.

## Conclusion

This study showed that about half of postmenopausal women in the rural areas of Iran had HTN and more than 42% of them were pre-hypertensive in 2001, 2007, and 2016. These findings signify the need for effective preventive, educational, and screening interventions in this group. Given the fact that women make up half of the population, and the age of the population is rising, and thus, the number of postmenopausal women is constantly rising, and due to the relatively high prevalence of HTN and cardiovascular risk factors in these women, it is crucial to implement prevention, treatment, screening, and follow-up programs in postmenopausal women. Moreover, as

the study revealed, among the postmenopausal women in our community, there is a high prevalence of obesity, DM, hyperlipidemia, pre-HTN, and HTN. Thus, policymakers should implement some strategies in order to improve women's lifestyles.

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### Conflict of Interests

Authors have no conflict of interests.

### Authors' Contribution

MEB: Implementer, data collection, and author

AK: Monitoring of article writing and implementation of the project

AF: Statistical advice and monitoring of the article writing

HA: Implementation of the project

NK: Conceptualization and writing of the article

NS: Monitoring of article writing and implementation of the project

All the authors approved the final version of the manuscript

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