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Original Article

High Blood Pressure Associated with Depression, Not Anxiety: Results from the Tabriz Older People Survey (TOPS)

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Abstract

Objectives: To investigate the relationship between depression/anxiety and hypertension (HTN) in a large population-based sample in Iran.

Design: A cross-sectional study.

Setting(s): Tabriz, the capital of East Azerbaijan province in northwest Iran.

Participants: A total of 1362 individuals were chosen from a representative sample of community-dwelling older adults aged 60 and above, residing in Tabriz. Participants were selected using the probability proportional to size sampling method.

Outcome measures: A structured survey was used to measure socio-demographic variables, along with the hospital anxiety and depression scale. Blood pressure (BP) was measured using a standard mercury sphygmomanometer.

Results: The results of a multiple logistic regression revealed that age (70-79 years old; $P=0.01$), employment status (housewives; $P=0.02$), level of education (illiterate; $P<0.01$), smoking status (having quit smoking; $P<0.01$), and depression ($P=0.02$) were related to HTN among these older adults.

Conclusions: These findings highlight the critical importance of integrating mental health assessments and interventions in HTN management and prevention strategies, particularly for older populations.

Keywords: Hypertension, Depression, Anxiety, Coronary heart disease, Aged

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Introduction

High blood pressure (BP) accounts for around 8.5 million deaths worldwide.[1,2] Hypertension (HTN) is one of the largest contributors to cardiovascular disease (CVD), which is the leading cause of death globally.[3] HTN affects approximately one-quarter of all adults and is globally recognized as a leading cause of death and the third largest cause of disability-adjusted life years.[4] It accounts for about half of all heart disease and stroke-related deaths worldwide. Furthermore, there is some evidence that the world is experiencing an increase in the prevalence of HTN, which has also been observed in Iran. The prevalence of HTN among older adults in the same study setting in Iran showed that HTN increased from 68% in 2015[5] to more than 80% in 2019.[6] According to Kearney and colleagues' report, the total number of adults with HTN will increase to 1.56 billion worldwide by 2025.[7]

HTN is associated with a high incidence of debilitating complications, such as stroke, myocardial infarction, and renal insufficiency, which together impose a huge economic burden on society. Estimates demonstrate that globally, 54%-64.6% of strokes and 47% of coronary

heart disease are caused by HTN. The prevalence of HTN increases with age, and it is estimated to affect 65% of individuals aged 60 and above.[8]

The worldwide population is aging, with estimates suggesting that 20% will be at least 65 years old by 2030. Therefore, the impact of HTN on mortality among older adults will increase over the coming decades.[8] In Iran, research has found the overall prevalence of HTN to be 52.0% and 44.3% among Iranians (48.2% on average) and among Iranian men and women, respectively. This prevalence is known to increase with age in older adults of both genders, according to the American College of Cardiology/American Heart Association guidelines.[9]

HTN has a multifactorial etiology in which genetic, environmental, and psychological factors are all important.[10] Given the complex physiological processes involved in HTN, the relationship between psychosocial factors and HTN is not fully understood yet.[11] Psychological factors are considered important and influence health in general and the cardio-metabolic pathways in particular.[12] Furthermore, there is a general relationship between mental health disorders and CVD risk factors.[8]

Anxiety and depression play a significant role in the global burden of the disease and were predicted to be the second most common cause of disability by 2020.[13] Clinical and subclinical depression have been found to be risk factors for HTN in middle-aged and older adults.[14] The prevalence of depression in older adults is 40.6%, which is higher among women (50%) than among men (32%).[15] It is unclear whether depression usually precedes CVD or whether depression is a secondary symptom of CVD .[16] Mental stress is the physiological mechanism through which depression can cause CVD, or at least exacerbate it. Stress activates the hypothalamic-pituitary-adrenal axis and leads to an increase in cortisol levels. Subsequently, the over-activation of the sympathetic nervous system results in increased levels of cortisol in circulation and finally leads to increased BP.[17,18]

Anxiety is one of the most common psychiatric diseases in adults that damages the affected people's health and their quality of life.[11] Stress, which can be triggered through anxiety, changes the circulating catecholamine levels, which can have an adverse effect on autonomic and hormonal homeostasis. This eventually can lead to inflammation, metabolic abnormalities, endothelial dysfunction, HTN, and insulin resistance.[19] Furthermore, unhealthy and harmful behaviors caused by stress and anxiety can adversely affect healthy habits. Unhealthy habits such as a lack of physical activity and increased appetite, smoking, and alcohol abuse are other factors that can cause HTN.[20]

The association between depression, anxiety, and HTN is not yet well understood, and the research findings have been inconsistent in this regard. Some studies have shown that depressive and anxiety disorders are associated with HTN,[21] whereas others have found no association in this respect.[22] In contrast, several studies have found depression/anxiety to be related to hypotension.[4,23] Due to these complex and conflicting findings, the present study sought to explore the relationship between depression/anxiety and HTN in a large population-based sample from the Tabriz region of Iran.[6]

Methods

The Tabriz Older People Health Survey research, a cross-sectional study, used multi-stage cluster sampling to study adults aged 60 years and above in Tabriz, Iran. Using demographic information obtained from the Statistical Center of Iran, 140 blocks were selected from the 11 778 city blocks in Tabriz, and 10 older adults were randomly chosen from each urban block (1400 people from 140 urban blocks), which resulted in a total of 1362 participants. The required data were gathered at the residence of participants by the trained interviewers. The sampling methods have been described in detail elsewhere.[6]

The study protocols were reviewed and approved by the Ethics Committee of Tabriz University of Medical Sciences. In addition, informed consent was obtained from all study participants. A structured survey was used to investigate socio-demographic variables, as well as the Hospital Anxiety and Depression Scale (HADS). BP was measured using a standard mercury sphygmomanometer. Descriptive and inferential statistics, including chi-square and multiple logistic regression tests, were undertaken using SPSS 21 software.

Procedure and Measurements

The questionnaire consisted of three sections. The first section asked questions about sociodemographic characteristics, including date of birth, gender, marital status, and level of education. In the second section, after participants had rested for five minutes, BP measures were taken from the right and left arms by trained research assistants using a standard mercury sphygmomanometer. HTN was defined as systolic BP ≥ 140 mm Hg and/or diastolic BP ≥ 90 mm Hg in the right and/or left arms.[24] Participants using anti-hypertensive medications were also classified as having HTN, regardless of their measured BP. The third section consisted of the HADS. The HADS is a self-reported scale for screening anxiety and depression symptoms across a broad range of patients and the general public.[25] The questionnaire includes 14 items divided into two subscales, namely, HADS-A (anxiety-related items) and HADS-D (depression-related items). The answers are made using a 4-point Likert-type scale, with scores ranging from 0 to 3. The total score of each subscale ranges from 0 to 21, and a higher score reflects higher levels of anxiety and depression. Scores 0–7 and 8–10 are categorized as normal and borderline or mild depression, respectively, and scores 11–21 are considered abnormal, which is also categorized into 11–14 and 15–21 as

moderate and severe depression, respectively.[26]

The reliability and validity of the Iranian version of the scale have been previously supported by psychometric research, showing that the reliability o3results.[27]

Results

The mean ± standard deviation (SD) age of participants was 70.09 (±7.88) years, and 56% were female. More than half of the older people (55%) were in the 60–69 age decade, most of whom were housewives (46%), and 49% were illiterate. Based on the results (Table 1), the chi-square tests demonstrated that there were significant differences between the normotensive and the hypertensive groups regarding age group, gender, marital status, employment status, educational level, and tobacco use.

The significant variables ($P < 0.2$) were exported to a multiple logistic regression model to provide a predictive model for estimating HTN in older people. Given that the relationship between anxiety and HTN was not significant ($P = 0.75$), this relationship was not examined using the logistic regression.

The results of multiple logistic regression analysis revealed that decades of age, employment status, level of education, smoking, and depression were related to the BP levels of older adults (Table 2). The findings (Table 2) also indicated that older adults aged 70–79 years old were 2.18 times more likely to suffer from HTN than those aged > 80 years old ($P = 0.01$). The risk of HTN was 3.72 times higher in housewives than among previously employed retired older adults ($P = 0.02$). HTN was 2.93 times higher among illiterate older people than among those with university degrees ($P < 0.01$), and those with only primary education had a 2.23 times higher chance to develop HTN than older adults with university degrees ($P < 0.01$). In addition, HTN was less common among those with university degrees compared to those with seminary and Quranic literacy education (OR = 4.48, $P < 0.01$).

Older adults with moderate depression had a 1.81 times higher chance of having HTN in comparison to those without depression (OR = 1.81; 95% CI: 1.12-2.92, $P = 0.02$). Furthermore, the risk of having HTN was 2.58 times higher in older adults who had given up smoking than in those who were always non-smokers ($P < 0.01$).

Table 1. Participant Characteristics and Blood Pressure values Among Older Adults

Variable		BP Status		*P* Value[a]
		Normotensive N (%)	Hypertensive N (%)	
Age	60-69	127 (17.1)	614 (82.9)	0.04
	70-79	52 (12.1)	379 (87.9)	
	≥80	35 (18.4)	155 (81.6)	
Anxiety	Normal	111 (14.9)	634 (85.1)	0.75
	Borderline	43 (15.8)	230 (84.2)	
	Abnormal	53 (16.7)	264 (83.3)	
Gender	Male	127 (21.4)	467 (78.6)	<0.01
	Female	87 (11.3)	681 (88.7)	
Marital status	Married	176 (17.8)	814 (82.2)	<0.01
	Single	38 (10.2)	334 (89.8)	
Employment status	Retired	67 (18.4)	298 (81.6)	<0.01
	Employed	22 (25.3)	65 (74.7)	
	Retired (employed)*	5 (31.2)	11 (68.8)	
	Unemployed	16 (13.3)	104 (86.7)	
	Housewife	68 (10.9)	557 (89.1)	
Educational level	Illiterate	80 (12.2)	577 (87.7)	<0.01
	Primary	49 (15.5)	268 (84.5)	
	Middle school	25 (21.2)	93 (78.8)	
	High school	12 (25.5)	35 (74.5)	
	Diploma	20 (21.7)	72 (78.3)	
	University degree	24 (28.9)	59 (71.1)	
	Other (Seminary, Quranic literacy)	4 (8.3)	44 (91.7)	
Smoking	Non smoker	157 (13.9)	975 (86.1)	<0.01
	Smoker	36 (26.7)	99 (73.3)	
	Quit-Smoking	21 (22.1)	74 (77.9)	
Hookah use	Non smoker	201 (15.5)	1,092 (84.5)	0.72
	Smoker	5 (17.2)	24 (82.8)	
	Quit-smoking	8 (20.0)	32 (80.0)	
Depression	Normal	54 (22.3)	188 (77.7)	<0.01
	Mild	73 (16.0)	384 (84.0)	
	Moderate	69 (11.9)	513 (88.1)	
	Severe	10 (19.6)	41 (80.4)	
Anxiety	Normal	111 (14.9)	634 (85.1)	0.75
	Borderline case	43 (15.8)	230 (84.2)	
	Abnormal	53 (16.7)	264 (83.3)	

Note. *People who have been retired but are occupied in another paid job; [a] *P* value calculated by chi-square test.

Discussion

This study assessed the relationship between BP and both depression and anxiety. The results showed that having depression, especially moderate depression, was significantly related to a higher BP. In contrast to our expectations, the relationship between anxiety and BP was not significant. Moreover, the findings confirmed that age, decade, employment status, level of education, and smoking status were associated with high BP.

The results indicated that although the prevalence of HTN increases with age, this increasing trend does not continue with increasing age above 80 years. As age advances, there is a greater prevalence of arterial stiffening and HTN. Epidemiological studies have shown that arterial stiffness, HTN, and related CVDs are more prevalent in older adults than in younger ones.[28-30] It is noteworthy that changes are not always linear. In line with the results of the present study, a systematic review demonstrated that the prevalence of HTN decreases in the oldest old.[29] Probably, this change can be explained by considering life expectancy such that most of the high-risk older people do not reach the oldest groups due to different causes of

Table 2. Multiple Logistic Regression Analysis on Identifying Blood Pressure Risk Factors Among Older Adults

Variable		Hypertensive		OR (95% CI)	*P* Value
		Count	%		
Gender	Male	467	78.6	Reference category	
	Female	681	88.7	1.35 (0.73–2.51)	0.34
Age	60-69	614	82.9	1.42 (0.80–2.52)	0.24
	70-79	379	87.9	2.18 (1.98–3.97)	0.01
	>80	155	81.6	Reference category	
Marital status	Married	814	82.2	Reference category	
	Single	334	89.8	1.45 (0.89–2.37)	0.14
Occupational status	Retired	11	68.8	Reference category	
	Employee	65	74.7	1.34 (0.42–4.29)	0.62
	Retired (employed)*	298	81.6	2.02 (0.68–6.12)	0.21
	Unemployed	104	86.7	2.95 (0.91–9.62)	0.07
	Housewife	557	89.1	3.72 (1.25–11.03)	0.02
Educational level	Illiterate	577	87.8	2.93 (1.73–4.98)	<0.01
	Primary	268	84.5	2.23 (1.27–3.91	<0.01
	Middle school	93	78.8	1.51 (0.79–2.89)	0.21
	High school	35	74.5	1.19 (0.53–2.66)	0.68
	Diploma	72	78.3	1.46 (0.74–2.91)	0.28
	University degree	59	71.1	Reference category	
	Other (Seminary, Quranic literacy)	44	91.7	4.48 (1.45–13.83)	<0.01
Depression	Normal (0-7)	188	77.7	Reference category	
	Mild (8-10)	384	84.0	1.38 (0.86–2.21)	0.18
	Moderate (11-15)	513	88.1	1.81 (1.12–2.92)	0.02
	Severe (>15)	41	82.0	0.78 (0.32–1.87)	0.58
Smoking	No	975	86.1	Reference category	
	Quitted	74	77.9	2.58 (1.49–3.43)	<0.01
	Yes	99	73.3	1.28 (0.69–2.37)	0.43

Note. CI: Confidence interval; *People who have been retired but are occupied in another paid job.

death. This trend change may be different according to life expectancy in other societies.

It is widely known that depression is related to HTN, but whether depression is a risk factor for HTN remains controversial. Our findings are consistent with those of other research that has found a relationship between depression and BP.[31,32] However, this finding is inconsistent with that of previous research that reported that depression was not associated with HTN.[33] Additionally, the findings of a longitudinal study of 36,530 adults, who were followed over 11 years, revealed that the symptoms of depression predicted lower BP.[23]

The physiological mechanism through which depression can lead to or intensify CVD is psychological stress, which activates the hypothalamic-pituitary-adrenal axis and leads to higher BP.[34] Moreover, the unhealthy behaviors of people with HTN (e.g., risky drinking and physical inactivity) and comorbid depression are also mechanisms that might explain the association between depression and CVD.[31,34]

Since the early twentieth century, the role of anxiety in the development of HTN has been controversial. Several studies have been conducted to investigate the association between anxiety and HTN, and these have produced contradictory findings.[8,35,36] The results of our study showed that there was no association between anxiety and HTN, which contradicts those of other studies that have reported anxiety to be associated with HTN, implying that individuals with anxiety have a higher risk of HTN than those without anxiety.[10,37] Furthermore, it has also been reported that people with HTN are more likely to have anxiety than those without HTN.[38,39] However, our result is in agreement with those of several other studies that failed to support the role of anxiety in the development of HTN.[22,36,40] For example, using data from the CARDIA study, Yan et al found that anxiety was not associated with an increased risk of HTN.[22]

The lack of consistency among the studies investigating the relationship between anxiety and HTN is probably due to differences in the research designs, the lack of well-validated standardized measures, as well as the absence of follow-up and outcome definitions. One possible explanation for our results might be the fact that our measures of anxiety were not obtained in a clinical or formal setting, which is normally used for the diagnosis

of clinical anxiety. Further, our study was a cross-sectional study, which did not allow us to determine the causality of any associations.

The etiology and intensity of HTN, at any point in time, are multi-dimensional and include behavioral factors (diet, physical activity, and alcohol), genetic predisposition, environmental stress, and psychological factors (e.g., environmental, situational, and genetic).[22] It has been suggested that individuals with mental health problems visit health service providers more often, and this higher frequency of visits probably results in more BP measures and more BP-related follow-up appointments.[8] Another explanation might be related to the difference between trait anxiety and state anxiety. The hypothalamic–pituitary–adrenal axis and norepinephrinergic sympathetic nervous system are linked to trait and state anxiety, respectively. State anxiety has been found to increase BP in situations such as visiting a hospital or medical clinic,[41] which was not the case in our study, and may account for the absence of a relationship between anxiety and BP in our study.

The results of our study also showed that HTN was associated with educational level, which is in line with the results of other studies. A number of previous studies have found a higher educational level to be associated with a lower prevalence of HTN.[42-44] There are several reasons to explain the relationship between a low educational level and HTN, including a lack of awareness about the disease, lack of a healthy lifestyle (e.g., poor diet and little exercise), and insufficient knowledge about how to prevent HTN.[42,43] People with a high educational level have more knowledge and information about HTN, and subsequently, they are more likely to have a healthier lifestyle.[44]

The findings of the present study also revealed that individuals who had quit smoking were more likely to have HTN than non-smokers, which contradicts the results of previous studies, demonstrating lower BP among smokers than in former smokers.[45] In addition, Ruben et al found that cigarette smoking may be a modest, but important, risk factor for the development of HTN.[46] Furthermore, a study by Okubo et al reported that BP was lower in smokers than in non-smokers and ex-smokers. However, when taking lifestyle and other confounding factors into consideration, there was no significant dose-effect relationship between smoking and BP.[47] In contrast, another study reported no significant relationship between smoking and HTN.[48]

Although it is well-established that smoking has many detrimental health effects, there remains some controversy regarding the relationship between smoking and HTN, and smoking cessation is not without 'side effects'. The mechanism through which quitting smoking can lead to higher BP might be via weight gain[49] and the development of metabolic syndrome, which itself amplifies age-associated increases in vascular stiffness.[50] In addition, smoking cessation reduces inflammation but may lead to weight gain.[51,52] Research has confirmed the strong relationship between obesity and high BP and has identified obesity as the most important risk factor for HTN and CVD [53]. Therefore, while searching for more effective programs to encourage smoking cessation, there is also a growing interest in the prevention of weight gain.[54]

The association of HTN with age has been reported in several different studies.[55,56] The results showed that although the prevalence of HTN increases with age, this increasing trend does not continue with increasing age above 80 years. As age advances, there is a higher prevalence of arterial stiffening and HTN.[57] Epidemiological studies have shown that arterial stiffness, HTN, and related CVDs are more prevalent in older adults than in younger ones.[28-30] It is noteworthy that the changes are not always linear. This trend change may be different according to life expectancy in different societies. In line with the results of the present study, Renu Rani et al found that the prevalence of HTN increased with age and was the highest in the age group of ≥ 70.[55] A systematic review has shown that the prevalence of HTN decreases in the oldest old.[29] These nonlinear associations are in agreement with our study results. This finding can be explained in several ways. One reason for this finding is that medication use increases up to age 79 but decreases after 80 years old. In addition, physicians treat "very old" hypertensive individuals differently from "young elderly" individuals. Despite more uncontrolled BP, higher systolic BP, and more HTN-RC in the "very old", clinicians prescribe fewer medications for them due to the side effects of drugs in very elderly individuals.[56] Another probable explanation is by considering life expectancy such that most high-risk older people do not reach the oldest groups due to different causes of death. In fact, healthy seniors have more chances to reach the oldest old period and are often fitter than those a few years younger.

Finally, the findings revealed that women who were housewives were more at risk of having HTN. In agreement with our research, Azizi et al reported that the physical and biochemical risk factors for non-communicable diseases, including high BP, were higher in housewives than in employed women. This finding might be due to excessive responsibilities for house chores, which prevent them from taking part in physical activities and paying attention to their personal health. An unhealthy lifestyle, including poor nutrition, can cause several diseases to develop, including HTN.[58]

Study Limitations

This study has several strengths, most notably the sample size and representativeness. However, this study has many limitations. As with other cross-sectional studies, a major limitation is that no causal conclusions can be drawn. Additionally, the use of a self-report scale instead of the baseline measure of depression is another limitation that may have led to an overestimation of depression and anxiety prevalence.

Conclusions

In general, psychological disorders, such as depression,

can be regarded as important factors that influence health in general and in particular HTN. Therefore, it is highly important to address psychological factors, especially depression, when treating HTN. Identifying and treating depression can be effective approaches for preventing and treating HTN.

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Data availability statement

Data gathered for the study are available from the corresponding author upon reasonable request.

Ethical approval

The study protocols were reviewed and approved by the Deputy of the Research Ethics Committee of Tabriz University of Medical Sciences (Ethical ID: TBZMEDREC.1395.684).

Conflict of interests

The authors declare that they have no conflict of interests.

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