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Original research

ASSOCIATED FACTORS OF PREHYPERTENSION IN POPULATION AGED 40 AND ABOVE IN HUE CITY: A COMMUNITY-BASED CROSS-SECTIONAL RESEARCH

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ABSTRACT

Background: *Prehypertension is a common condition that directly impacts public health. Developing preventive strategies for prehypertension is a significant method in reducing the incidence of hypertension. This study aimed to identify associated factors of prehypertension among individuals aged ≥ 40 years old in Hue City.*

Methods: *A cross-sectional descriptive study was conducted from January 2024 to August 2024, involving 639 individuals aged ≥ 40 years old in Thua Thien Hue province, the former of Hue City nowadays.*

Results: *The prevalence of prehypertension among the study population was 27.7%. Multivariate logistic regression analysis revealed the following factors to be significantly associated with prehypertension: age 70 years and older (OR = 2.46; 95% CI: 1.22 - 4.96); a personal history of dyslipidemia (OR = 1.93; 95% CI: 1.05 - 3.55); a family history of hypertension (OR = 2.38; 95% CI: 1.56 - 3.65); overweight or obese (OR = 2.19; 95% CI: 1.45 - 3.32); moderate to heavy alcohol consumption (OR = 4.02; 95% CI: 1.61 - 10.05); low level of physical activity (OR = 1.68; 95% CI: 1.11 - 2.55); and insufficient vegetable intake (OR = 1.69; 95% CI: 1.05 - 2.70).*

Conclusion: *Interventions to modifiable factors are necessary to reduce the prevalence of prehypertension, as in hypertension, and prevent its progression to hypertension.*

Keywords: *Prehypertension, associated factors, prevention.*

I. BACKGROUND

Prehypertension affects approximately 25% to 50% of adults globally [1]. In Vietnam, prehypertension is also a significant public health concern. Statistical data indicate that prehypertension affects 41.8% of individuals aged 25-64 years, a rate double that of hypertension (20.7%) [2]. According to the 2022 guidelines of the Vietnam National Heart Association, the primary recommendation for managing prehypertension is lifestyle modification, with pharmacological treatment considered in individuals with very high cardiovascular risk [3]. However, current healthcare efforts predominantly focus on the treatment of hypertension in clinical settings. The detection and education of prehypertension have not received adequate attention, and community-based health promotion for lifestyle modification is not extensive.

In recent years, the socio-economic condition of Thua Thien Hue province, the former Hue City, has improved, and the living standards of its residents have gradually advanced. Consequently, non-communicable diseases in general, and prehypertension in particular, are becoming increasingly prevalent. Some studies have shown a relatively high prevalence of prehypertension in the community. Among individuals aged 25-84

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years in Thua Thien Hue province, the prevalence is 26.5% [4]. The prevalence in Nam Dong district and Huong Thuy town is 27.5% and 20%, respectively [5, 6]. Study on associated factors and preventive strategies for prehypertension is a matter of practical significance, contributing to a reduction in the incidence of hypertension. Therefore, we conducted this study to identify some factors associated of prehypertension among individuals aged 40 years and older in Hue City.

II. SUBJECTS AND METHODS

2.1. Study population

The study population comprised individuals aged 40 years and older who were current residents of Thua Thien Hue province.

Exclusion criteria included individuals who did not consent to participate in the study; individuals newly diagnosed with hypertension, with a prior history of hypertension, or currently receiving treatment for hypertension; and individuals with mental health issues or disabilities that limited normal communication.

2.2. Sample size and data collection

Data collection: from August 2023 to August 2024.

Sample size calculation: Applying the sample size calculation formula for estimating a population proportion [7]:

$$n = \frac{z^2_{1-\frac{\alpha}{2}} \cdot p\,(1-p)}{d^2}$$

n: Minimum required sample size for the study; Z1-α/2: Z-score corresponding to a 95% confidence level, which is 1.96; p: Estimated prevalence of prehypertension. Based on the study by Nguyen Thi Tu Trang et al., the prevalence of prehypertension among individuals aged 40 years and older in Cu Kuin district, Dak Lak province in 2019 was 33.2%, hence p = 0.332 [8]; d: Desired absolute precision, set at d = 0.04.

Substituting these values into the formula, the minimum required sample size is 532. The actual sample size in our study was 639 individuals.

Data collection methods: Data were collected using a pre-designed questionnaire and by performing blood pressure measurements on participating individuals.

2.3. Research methodology

Study design: A cross-sectional descriptive study.

Sampling method: A multistage sampling method was employed for participant selection.

Stage 1: Four districts/cities within the province were selected based on geographical and socio-economic conditions.

Stage 2: Within each of the selected districts/cities, two communes/wards were randomly chosen.

Stage 3: Study participants meeting the inclusion criteria (≥ 40 years of age and exclusion of a prior history of hypertension, current treatment for hypertension, and newly detected hypertension through screening) were then selected.

2.4. Study variables

Prehypertension: Defined as systolic blood pressure ranging from 130-139 mmHg and/or diastolic blood pressure ranging from 85-89 mmHg [3].

Risk Behaviors: Smoking status, physical activity levels, alcohol consumption, and salt intake were assessed according to the World Health Organization's guidelines on risk factors for non-communicable diseases [9]. Overweight and obesity were classified based on the Body Mass Index (BMI) assessment criteria for Asian populations [9].

2.5. Data analysis

The collected data were entered into a computer using Epidata 3.1 software. Subsequently, SPSS version 22.0 was utilized for data analysis and processing, including descriptive statistics such as frequencies and percentages for categorical variables, and means and standard deviations for continuous variables. For inferential statistics, a multivariate logistic regression model was employed to analyze the associated factors.

III. RESULTS

3.1. Characteristics of the study population

Among the 639 participants, the 50-59 age group constituted the largest proportion, at 29.7%, with the mean age of the participants being 60.4 years. 57% of the research population were females. Most participants (99.1%) were of Kinh ethnicity, and 90.3% resided in urban, delta, or coastal areas, while 9.7% lived in mountainous regions. The prevalence of prehypertension among the study participants was 27.7% (Table 1).

Table 1: Classification of blood pressure status of the study participants

Blood pressure condition	n	%
Prehypertension	177	27.7
Normotension	462	72.3
Total	639	100.0

3.2. Factors associated with the prevalence of prehypertension among individuals aged 40 years and older in Thua Thien Hue province

Following univariate analysis of clinical characteristics, and cardiovascular risk factors, 10 factors showed statistically significant differences between the prehypertension and normotension group, including age group (p = 0.009); gender (p = 0.014); personal history of diabetes mellitus (p = 0.03); personal history of dyslipidemia (p = 0.008); family history of hypertension (p < 0.001); BMI category (p = 0.002); smoking status (p = 0.025); level of physical activity (p = 0.009); level of alcohol consumption (p = 0.002); and vegetable consumption (p = 0.046).

The results of the multivariate logistic regression analysis indicated that age, personal history of dyslipidemia, family history of hypertension, BMI category, level of alcohol consumption, physical activity level, and vegetable consumption were statistically significantly associated with the prehypertension status of the study participants. Besides, there was no statistically significant association observed between gender, personal history of diabetes mellitus, and smoking status with the prehypertension status of the study participants (p > 0.05) (Table 2).

Table 2: Multivariate logistic regression model examining factors associated with prehypertension among study participants

Variables		OR	95% CI		p
Age group	40 - 49	1			
	50 - 59	1.00	0.57	1.76	0.988
	60 - 69	1.61	0.91	2.84	0.101
	≥ 70	2.69	1.47	4.90	0.001
Gender	Female	1			
	Male	1.42	0.77	2.60	0.257
History of diabetes mellitus	No	1			
	Yes	1.32	0.62	2.83	0.470
History of dyslipidemia	No	1			
	Yes	2.00	1.09	3.68	0.025
Family history of hypertension	No	1			
	Yes	2.32	1.52	3.54	< 0.001
BMI category	Underweight/Normal	1			
	Overweight/Obesity	2.19	1.45	3.29	< 0.001

Variables		OR	95% CI		p
Smoking status	Non-smokers	1			
	Ex-smoker	1.11	0.55	2.21	0.776
	Current smoker	1.11	0.57	2.14	0.764
Level of Alcohol consumption	Non-drinker/light	1			
	Moderate/Heavy	4.00	1.61	9.95	0.003
Level of physical activity	Moderate/High intensity	1			
	Low intensity	1.69	1.12	2.56	0.013
Vegetable consumption	Sufficient vegetable intake	1			
	Insufficient vegetable intake	1.66	1.04	2.65	0.034

BMI: Body mass index; CI: Confident interval; OR: Odd ratio

IV. DISCUSSION

The multivariate logistic regression analysis revealed that age group, personal history of dyslipidemia, family history of hypertension, BMI category, level of alcohol consumption, physical activity level, and vegetable consumption were statistically significantly associated with prehypertension status among the study participants ($p < 0.05$).

Our study demonstrated an increasing trend in the prevalence of prehypertension with advancing age ($p < 0.05$). Compared to the 40-49 year age group, individuals aged 70 years and older had a 2.69-fold likelihood of having prehypertension (95% CI: 1.47 - 4.90). Numerous studies have shown a similar association between age and the risk of prehypertension, consistent with our findings. In the Americas, a study conducted on Peruvian adults aged 18 to 59 years by Akram Hernández-Vásquez et al. reported that those aged 50-59 years had a 2.06 times higher risk of prehypertension (95% CI: 1.27 - 3.35) compared to the 18-29 year age group [10]. In Africa, Abdellatif Moussouni et al.'s research on 6,765 Algerian adults aged 18 to 69 years indicated that older age was associated with an increased likelihood of prehypertension [11]. In Vietnam, the 2020 study by To Muoi et al. involving 3,237 residents in Quang Nam province showed that individuals aged 45 years and older had a 1.42 times higher risk of prehypertension compared to the younger group (95% CI: 1.15 - 1.75) [12]. These studies collectively reinforce the role of age as a significant factor influencing the likelihood of prehypertension in the community.

Personal history of dyslipidemia was also identified as a risk factor for prehypertension in our study. The prevalence of dyslipidemia was 42.4% in the prehypertension group, significantly higher than the 26.2% observed in the normotensive group ($p = 0.008$). Individuals with a personal history of dyslipidemia had a 2.00 times higher likelihood of having prehypertension compared to those without (95% CI: 1.09 - 3.68). Several studies have indicated a higher prevalence of dyslipidemia in individuals with prehypertension compared to those with optimal blood pressure. In South Korea, the mean triglyceride level was significantly higher in the prehypertension group compared to the optimal blood pressure group [121.1 (79.5) mg/dL vs. 105.3 (70.1) mg/dL, $p = 0.004$], and the mean HDL-C level was significantly lower in the prehypertension group [48.1 (13.1) vs. 51.8 (15.1) mg/dL, $p < 0.001$] [13].

Our study, through the investigation of family history of non-communicable diseases, revealed that having a family member with hypertension increased the risk of prehypertension in the study participants. Individuals with a family history of hypertension had a statistically significantly higher

risk of prehypertension ($p < 0.001$). Multivariate analysis showed that a family history of hypertension was associated with a 2.32 times higher likelihood of prehypertension (95% CI: 1.52 - 3.54) compared to those without such a history. There are studies worldwide that have reported similar conclusions regarding the role of family history of hypertension in increasing the risk of prehypertension. A study conducted on 365 Indonesian students found that a family history of hypertension was a related factor for prehypertension, with individuals having a family history of hypertension having a 2.3 times higher risk of prehypertension compared to the rest (OR = 2.30, 95% CI: 1.24 - 4.28) [14]. A study in Nepal on older adolescents yielded similar results, with multivariate analysis showing that a family history of hypertension was associated with prehypertension (OR = 1.51, 95% CI: 1.06 - 2.17) [15]. Studies among the Vietnamese population have also demonstrated an association between a family history of hypertension and prehypertension [12, 16].

Overweight and obesity are leading risk factors for prehypertension. This has been demonstrated in studies globally and within Vietnam. In our research, overweight and obesity were associated with the prevalence of prehypertension ($p < 0.001$). In Indonesia, Aida Lydia's study on individuals aged 40 years and older across 13 provinces found that overweight and obese individuals had a higher risk of prehypertension compared to those with normal weight [17]. Specifically, overweight individuals had a 1.43 times higher risk (95% CI: 1.22 - 1.67), and obese individuals had a 1.75 times higher risk (95% CI: 1.54 - 1.99) [17]. Gulam Muhammed Al Kibria's assessment of prehypertension risk factors in 3,876 men and 3,962 women over 35 years of age in Bangladesh showed that overweight and obesity increased the prevalence of prehypertension in both genders [18]. Studies in various provinces of Vietnam by authors such as Do Ha, To Muoi, and Dang Thanh Nhan also indicated a statistically significant association between BMI and prehypertension [2, 12, 16]. Therefore, our study further reinforces the impact of overweight and obesity on the prevalence of prehypertension.

Alcohol consumption has a well-established association with blood pressure. For individuals consuming two or more alcoholic units daily, reducing alcohol intake is linked to a decrease in blood pressure levels [19]. Alcohol consumption was also identified as a risk factor for prehypertension in our study, consistent with numerous other investigations. Study participants with moderate to heavy alcohol consumption had a 4.00 times higher likelihood of prehypertension compared to those who did not consume alcohol or consumed at a low level (95% CI: 1.61 - 9.95). In China, Tao Xu et al. demonstrated that drinkers had a higher risk of prehypertension compared to other groups (OR = 1.147, 95% CI: 1.072 - 1.228) [20]. In Vietnam, the study by Dang Thanh Nhan et al. showed that regular beer/alcohol consumption increased the risk of prehypertension compared to the rest (OR = 1.19, 95% CI: 1.09 - 2.10, $p < 0.05$) [16]. According to the recommendations of the Vietnam National Heart Association, reducing alcohol consumption is a lifestyle modification that can lower blood pressure and enhance the effects of antihypertensive therapy [3]. Therefore, it is crucial to strengthen public health education regarding the harmful effects of alcohol on health, particularly its consequences for non-communicable diseases.

Physical activity at various levels contributes to reducing blood pressure. A meta-analysis of 17 studies worldwide demonstrated a strong relationship between physical activity and blood pressure levels. Intervention studies involving low- to high-intensity physical activity in sedentary individuals with normal blood pressure or prehypertension showed a reduction in both systolic and diastolic blood pressure, with systolic blood pressure decreasing by 2 to 5 mmHg and diastolic blood pressure decreasing by 1 to 4 mmHg [21]. Our study results indicated that a low level of physical activity was associated with a higher prevalence of prehypertension compared to moderate and high levels of physical activity. Participants who met the WHO recommendations for physical activity (moderate and high levels) had a 1.69 times higher likelihood of prehypertension compared to those who did not meet the recommendations (95% CI: 1.12 - 2.56). Similarly, a study in Malaysia assessing

factors related to prehypertension found that reduced physical activity was associated with a higher risk of prehypertension compared to moderate physical activity (OR = 3.43, 95% CI: 3.30 - 5.48) [14]. Thus, the association between the level of physical activity and the prevalence of hypertension observed in our study aligns with findings from other research in Vietnam and globally.

A healthy diet is a key lifestyle modification recommended by the Vietnam National Heart Association. The consumption of fruits, vegetables, whole grains, and low-fat dairy products contributes to a reduction in blood pressure ranging from 3 mmHg to 5 mmHg [3]. Our study results showed a significant association between the habit of consuming green vegetables/fruits and the prevalence of prehypertension ($p < 0.05$). Therefore, encouraging the population to increase their daily intake of vegetables/fruits is an important consideration for minimizing the risk of prehypertension and non-communicable diseases in general.

Modifiable cardiovascular risk factors offer opportunities for lifestyle interventions, thereby reducing the prevalence or slowing the progression of hypertension and prehypertension within the community. In our study, these modifiable risk factors included BMI, smoking status, level of physical activity, alcohol consumption, and vegetable consumption. These findings align with cardiovascular and hypertension risk factors highlighted in various guidelines from the Vietnam National Heart Association [3], albeit to varying degrees. Consequently, public health campaigns and interventions aimed at reducing the risk of cardiovascular diseases in general, and hypertension specifically, will contribute to lowering the risk of prehypertension.

V. CONCLUSION

Interventions are warranted to reduce the prevalence of prehypertension, prevent its progression to hypertension, and mitigate the risk of serious target organ damage complications.

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Ethical approval

The study received ethical approval from the Biomedical Research Ethics Committee of the University of Medicine and Pharmacy, Hue University (Approval Number: H2023/145).

Conflict of interest statement

The authors declare that there are no conflicts of interest regarding the research, authorship, and publication of this manuscript.

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