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Original Article

Prevalence of prehypertension and its associated factors among adults visiting outpatient clinic in Northeast Malaysia

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الملخص

أهداف البحث: "ما قبل فرط ضغط الدم" يشير إلى ضغط الدم ١٢٠ - ١٣٩ مم زئبق الانقباضي أو ٨٠ - ٨٩ مم زئبق الانبساطي. إن تقدير معدل انتشار "ما قبل فرط ضغط الدم" في السكان وتحديد العوامل المرتبطة بالقلب والأوعية الدموية مهم لتقليل الوصول لفرط ضغط الدم. تهدف هذه الدراسة لتحديد معدل انتشار "ما قبل فرط ضغط الدم" وعوامله المرتبطة بين الماليزيين البالغين.

طرق البحث: في ٢٠١٥ أجريت دراسة مستعرضة بين البالغين في العيادات الخارجية شمال شرق ماليزيا. أجريت مقابلة وجها لوجه باستخدام النسخة الملاوية والإنجليزية لاستبانة مراقبة (الأمراض غير المعدية) الماليزية. تحوي هذا الاستبانة على المعلومات الاجتماعية والديموغرافية، وحالة نمط الحياة والبيانات الأنثروبومترية. كما تم قياس ضغط الدم ثلاث مرات بواسطة مقياس ضغط الدم، تم تجاهل قيمة القياس الأولى وتم تسجيل متوسط ضغط الدم من القراءتين الأخرى للمزيد من تحليل البيانات. تم عمل الانحدار اللوجستي لتحليل العوامل المرتبطة لما قبل فرط ضغط الدم.

النتائج: انضم ١٥١ بالغا لهذه الدراسة بمعدل انتشار "ما قبل فرط ضغط الدم" ٣٧.١٪. كانت العوامل المرتبطة مع ما قبل فرط ضغط الدم في هذه الدراسة العمر، الذكور ومحيط الخصر غير الطبيعي كما تم تسجيله بواسطة تحليل الانحدار اللوجستي المتعدد.

الاستنتاجات: في هذه الدراسة معدل انتشار ما قبل فرط ضغط الدم أعلى من معدل انتشار فرط ضغط الدم المنشور في الأدبيات. العمر، الجنس ومحيط الخصر غير الطبيعي هي عوامل مرتبطة ذات دلالة تؤدي إلى "ما قبل فرط ضغط الدم".

الكلمات المفتاحية: العوامل المرتبطة؛ فرط ضغط الدم؛ ما قبل فرط ضغط الدم؛ انتشار؛ محيط الخصر

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Abstract

Objectives: Prehypertension refers to a systolic blood pressure of 120−139 mmHg systolic or a diastolic blood pressure of 80−89 mmHg. Estimation of the prevalence of prehypertension in the population and identification of cardiovascular associated factors are important to reduce progression to hypertension. This study aimed to determine the prevalence of prehypertension and its associated factors among Malaysian adults.

Methods: In 2015, a cross-sectional study was conducted among adults visiting an outpatient clinic in Northeast Malaysia. Face-to-face interviews were conducted using Malay and English versions of the Malaysia Non-Communicable Disease surveillance questionnaire. This instrument captured information about sociodemographic, lifestyle status, and anthropometric data. Blood pressure was measured three times with a sphygmomanometer, the first measurement value was discarded, and an average of blood pressure from the second two readings was recorded for further data analysis. Logistic regression was performed to analyse factors associated with prehypertension.

Result: A total 151 adults participated in the study, and the prevalence of prehypertension was 37.1% (95% confidence interval [CI]: 29.29, 44.69). Factors associated with prehypertension in this study were age (adjusted odds ratio [aOR] = 1.06 95% CI: 1.02, 1.11; *p* = 0.007), male sex (aOR = 4.44 95% CI: 1.58, 12.44; *p* = 0.005), and abnormal waist circumference (aOR = 31.65 95% CI: 11.25, 89.02; *p* < 0.001) as determined by multiple logistic regression analysis.

Conclusion: In this study, the prevalence rate of pre-hypertension of 37.1% is higher than that of hypertension reported in the literature. Age, male sex, and abnormal waist circumference are significant associated factors that lead to prehypertension.

Keywords: Associated factors; Hypertension; Pre-hypertension; Prevalence; Waist circumference

Introduction

Prehypertension is a new terminology that was first introduced in the guidelines of The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-7) in 2003.[1] "Prehypertension" is defined as a systolic blood pressure (SBP) of 120−139 mmHg and/or diastolic BP (DBP) of 80−89 mmHg. The term is intended to replace the phrase "borderline hypertension", which has been used previously. The older classification was complicated and did not convey the seriousness of the condition, whereas it has been noted that prehypertension itself is associated with cardiovascular risk and can progress to hypertension at twice the rate of those with lower values.

Based on data obtained from the National Health and Nutrition Examination Survey (NHANES) 1999−2000, the reported overall worldwide prevalence of prehypertension is 31%. According to the National Heart, Lung, and Blood Institute, the prevalence of prehypertension in 2008 was highest among younger adults aged 18−29 years old, and often undiagnosed.[2]

The overall prevalence of prehypertension in Malaysia is 37%,[3] a rate higher than the prevalence of hypertension itself. Two local studies showed prevalence rates of prehypertension among undergraduate university students of 42.9%[4] and 30.1%,[5] respectively. Both of these studies gathered data from adults aged 18−25 only; hence, a study to examine the prevalence of prehypertension within a wider age group in the community is needed.

An important risk of prehypertension for patients is the development of hypertension. The Trial of Preventing Hypertension Study (TROPHY) showed that rate of conversion to hypertension was 37% in 4 years for patients with higher than normal BP. In addition, it was found that over 4 years, almost two-thirds of patients diagnosed with pre-hypertension developed stage 1 hypertension.[6]

There are many factors associated with hypertension that can be classified as either modifiable or non-modifiable risk factors. Examples of non-modifiable risk factors are age, sex, ethnicity, and family history of hypertension. On the other hand, amount of physical activity, dietary intake, smoking, alcohol intake, and body weight are among the known and established modifiable risk factors for hypertension.

However, associated risk factors for prehypertension have not been well studied, and it is unknown whether they are the same as the risks for hypertension. This uncertainty has resulted in a lack of data regarding the association with other cardiovascular risk factors. The identification of modifiable or non-modifiable risk factors is important to reduce the possibility of developing further complications associated with cardiovascular disease (CVD). If the risk is identified at an earlier age, preventative behaviours can be established to prevent the onset of hypertension and reduce the prevalence of CVD.

The purpose of this study was to examine the prevalence of patients with prehypertension visiting an outpatient clinic in a tertiary hospital in Northeast Malaysia. We also aimed to identify significant associations between prehypertension and modifiable and non-modifiable risk factors using the Malaysia Non-Communicable Disease (NCD) surveillance questionnaire.

Materials and Methods

The present study was a cross-sectional study conducted at an outpatient clinic of the university hospital in Northeastern Peninsular Malaysia from 1 June 2015 until 30 September 2015. Convenience sampling was used, in which all adults who attended the clinic were approached, and those who agreed to undergo screening were then selected according to the inclusion and exclusion criteria. The exclusion criteria were: established hypertension; pregnancy; and chronic non-communicable diseases, such as diabetes, hypertension, hypercholesterolaemia, chronic and end-stage renal disease, and cancer. There were 155 individuals eligible for inclusion, and 151 completed the study, for a 97.4% response rate.

Our objectives

1. To determine the proportion of prehypertension among adults in Northeastern Peninsular Malaysia.
2. To identify the sociodemographic, lifestyle status, and anthropometric factors associated with prehypertension among adults in Northeastern Peninsular Malaysia.

Research tools and materials

1. Malaysia NCD (Non-Communicable Disease) surveillance questionnaire

The face-to-face interview was performed using the Malaysia NCD surveillance questionnaire, which consists of measurement of sociodemographic, lifestyle status, and anthropometric data[7] after the subjects consented to the study.

The Malaysia NCD surveillance questionnaire consists of three parts involving socio-demographic data, lifestyle status, and anthropometric measurement. The first part consists of sociodemographic data including age, sex, ethnicity, marital status, occupation, educational level, household income, and family history of hypertension. Lifestyle status data including smoking status and alcohol intake, level of physical activity, and dietary status were reported on the second part of the questionnaire. The third part consisted of anthropometric

data measurement, including height and weight, body mass index (BMI), BP, and waist circumference (WC).[7]

2. Anthropometric measurement

Height was measured using a stadiometer in centimetres (cm) with the patient standing in bare feet.

Body weight was measured using a Seca beam scale (in kg) with minimal clothing and no shoes.

WC was measured at the location between the rib cage and umbilicus, with the patient standing with the abdominal muscles relaxed, directly over the skin using soft tape. The measurement was read at the level of the tape (in cm).

BP was measured using a stethoscope and a mercury-stand sphygmomanometer. Before taking the BP, the patient was allowed to rest for 5 min with the legs uncrossed. The patient's right arm was placed on the table with the palm facing upward. The level of the cuff was kept at the same level as the heart during measurement. Three readings 1 min apart were taken on the same arm with the patient in the same position. The first reading was discarded and the latter two averaged.[8]

Data analysis

Data entry and analysis were performed using SPSS statistics version 22.0 (Statistical Package for the Social Sciences, IBM Corp., Armonk, NY, USA). Data were entered, reviewed for errors, explored, and cleaned.

The outcome variable was BP status ($0 =$ normal, $1 =$ prehypertension), whereas the independent variables were a mixture of categorical and numerical variables. The associated sociodemographic (age, sex, ethnicity, marital status, education level, occupation, income, and family history of hypertension) and lifestyle status variables (smoking status and alcohol intake with physical activity level, and dietary status) were tabulated. All categorical variables were described as frequency and percentage. Numerical variables were described as mean (standard deviation [SD]). Variables with small numbers were collapsed to form meaningful combination variables.

The variables in the sociodemographic status were further classified to fit our data. Marital status was classified into two categories, married and non-married. Occupation was further classified into employed and unemployed. Based on the Economic Planning Unit, Prime Minister's Department 2005, household income status was further categorised into three levels: low (less than RM1000), medium (RM1001-3999), and high (more than RM4000). Level of education was classified as low (no formal education or primary school level), medium (secondary school), and high (diploma/certificate, degree, or postgraduate level).

Smoking status was categorised as smoker and non-smoker. A smoker was an individual with current use, at the time of the study, of cigarettes or other forms of smoking, whether pipes, cigars, or chewing tobacco, while non-smoker was a person who never smoked.[9]

Regarding physical activity level, metabolic equivalents (METs) were used in the analysis of physical activity. A MET is the ratio of work metabolic rate to resting metabolic rate. MET values are applied to vigorous and moderate intensity variables in the work and recreation settings. The total score can be expressed as MET minutes per week. Based on the International Physical Activity Questionnaire (I-PAQ) scoring protocol, the physical activity is categorised into low activity (no activity or some activity but not enough to meet moderate or high activity), moderate activity (3 or more days of vigorous activity at least 20 min/day), and high activity (vigorous activity at least 3 days, accumulating at least 1500 MET minutes/week). However, in this study, it was further categorised into low activity and moderate to high activity.

Dietary status was categorised into adequate (individuals who consumed at least 5 servings of fruits and vegetables/day) or inadequate (individuals who consumed less than 5 servings of fruits and vegetables/day).

Based on the International Classification of WHO (World Health Organization) Expert Consultation BMI for Asians, BMI was categorised into four groups: underweight (<18.5 kg/m^2), normal weight ($18.5-22.9$ kg/m^2), overweight ($23-27.4$ kg/m^2), obesity (≥27.5 kg/m^2). Based on WHO and International Obesity Task Force (IOTF), WC was a risk factor for adult Asians at ≥90 cm for men and ≥80 cm for women.

For the outcome variable, BP was categorised into normal (SBP < 120 mmHg and/or DBP < 80 mmHg) or prehypertension (SBP of $120-139$ mmHg or DBP of $80-89$ mmHg).[8]

Descriptive analysis was performed to determine the proportion of prehypertension among the subjects.

Simple logistic regression was used to select the preliminary variables with an association with prehypertension. Variables with p-value <0.25 and clinical importance were selected for variable selection in multiple logistic regressions. Forward and backward stepwise selections of variables were performed and possible two-way interactions were checked in the model. Assessment of preliminary model for fitness was performed using the Hosmer—Lemeshow goodness-of-fit test, classification table, and receiver operating characteristic (ROC) curve analysis. The Hosmer—Lemeshow test with p-value more than 0.05 indicated that the model was fit. The classification table showed a value $>70\%$ and the area under the ROC curve was >0.7 with a p-value <0.05, indicating that the model was fit. Data presentation and interpretation were reported and presented using crude odds ratios (OR) for simple logistic regression, adjusted odds ratio (aOR), 95% confidence interval (CI), the Wald statistic, and p-value. The level of significance was set at 0.05.

Results

A total number of 155 eligible adults were enrolled and 151 subjects completed the study, resulting in a 97.4% response rate.

Characteristics of respondents

The overall prevalence of prehypertension among the 151 respondents was 37.1% (95% CI: 29.29, 44.69). The sociodemographic, lifestyle status, and anthropometric data for the respondents with normal BP and prehypertension are shown in Table 1.

Table 1: Characteristics of respondents by BP classification (n = 151).

Characteristics	Normal, n (%)	Prehypertension, n (%)	p-Value
Age (years)[a]	28.9 ± 9.09	35.7 ± 12.91	<0.001
Sex			
Male	29 (51.8)	27 (48.2)	0.031
Race			
Non-Malay	7 (70.0)	3 (30.0)	0.633
Marital status			
Non-married	44 (63.8)	25 (36.2)	0.842
Occupation			
Unemployed	44 (69.8)	19 (30.2)	0.137
Education level			
Medium	28 (50.0)	28 (50.0)	0.153
High	62 (69.7)	27 (30.3)	0.487
Household income status			
Medium	51 (60.7)	33 (39.3)	0.458
High	15 (62.5)	9 (37.5)	0.683
Family history of hypertension			
Yes	48 (71.6)	19 (28.4)	0.049
Physical activity level			
Moderate/high activity	45 (60.8)	29 (39.2)	0.600
Smoking status			
Yes	5 (31.3)	11 (68.8)	0.009
Alcohol intake			
Yes	2 (66.7)	1 (33.3)	0.892
Dietary status			
Inadequate	81 (62.8)	48 (37.2)	0.940
BMI category			
Overweight	27 (60.0)	18 (40.0)	0.001
Obese	10 (24.4)	31 (75.6)	<0.001
Waist circumference			
Abnormal	12 (21.8)	43 (78.2)	<0.001

[a] Mean (±SD).

Table 2: Factors associated with prehypertension by multiple logistic regression (n = 151).

Characteristics	[a]Adjusted OR (95% CI)	p-value*
Age	1.06 (1.02, 1.11)	0.007
Sex		
Female	1	
Male	4.44 (1.58, 12.44)	0.005
Waist circumference		
Normal	1	
Abnormal	31.65 (11.25, 89.02)	<0.001

*Significant p-value < 0.05.
[a] Adjusted odds ratio. Confidence interval.

Factors associated with prehypertension

Simple and multiple logistic regression analysis were performed to determine the factors associated with prehypertension. There were statistically significant associations (p < 0.25) between prehypertension and age, sex, occupation, education level, family history of hypertension, smoking status, BMI, and WC. All variables including the clinically significant variables were included in the multiple logistic regression.

Table 2 shows that age, sex, and WC are factors associated with prehypertension according to multiple logistic regression.

There were no problems with multicollinearity and interaction. The Hosmer−Lemeshow test (p = 0.105), classification table (overall correctly classified percentage = 83.4%), and area under the ROC curve (86.0%) indicate that the model assumption was fit.

The final model (Table 2) is valid for interpretation. Age, sex, and WC were significantly associated with prehypertension in this study.

Discussion

In the present study, 56 adults (37.1%) were identified to have prehypertension. This value is lower than the prevalence of prehypertension in the United States (48.2%)[10] and higher than the rate reported in China (21.9%).[11] The prevalence is very similar to that described in other reports in South East Asian countries and Malaysia. For example, Widjaja et al. reported a prevalence of prehypertension of 34.2% among young adults aged 18 years and older in Indonesia.[12] In Vietnam, the percentage of adults with prehypertension was higher (41.8%), particularly in comparison to the prevalence of hypertension (20.7%).[13]

The national prevalence of prehypertension in Malaysian according to the Third National Health and Morbidity Survey (NHMS 3) was 37%.[7] Overall in Malaysia, the prevalence of prehypertension is in the range of 34%[14]−37%.[7] However, the age of the population included in the previous studies was 30 years old and above, whereas in our study, those included were adults aged 18 years and above. Two studies performed in Malaysia among young adults aged 18−29 years old demonstrated a prevalence of prehypertension of 34%[14] and 30.1%, respectively.[5] However, both of these studies were conducted among university students located in an urban area and did not truly represent the general population. The present study not only included all adults age 18 and above but also individuals with different backgrounds, thus reflecting a more complete picture of the general population compared to previous studies.

We found that age is significantly associated with prehypertension (p = 0.007) (aOR = 1.06 95% CI: 1.02, 1.11). This result indicates that with every 1-year increment of age the odds of developing prehypertension are 1.06 times higher. This finding was supported by previous studies showing that older age was associated with prehypertension.[15−17] This phenomenon is most probably due to the stiffening of the blood vessels as an individual ages.

The risk of developing prehypertension is 4.4 times higher in men than in women (aOR = 4.44 95% CI: 1.58, 12.44). Nasir et al. found similar results in a large community study conducted in urban and rural areas which revealed a prevalence of prehypertension of 34% and showed that the risk was 1.76 times higher in men than in women (aOR = 1.76 95% CI: 1.43, 2.17).[18] Grotto et al. found that being male was associated with almost double the risk of prehypertension (aOR = 1.93; 95% CI: 1.61, 2.31).[19] Two studies in India reported a significantly increased prevalence of prehypertension and hypertension among men and older individuals.[20,21] The reason for these findings might be the protective effect of the endogenous estradiol in women, which protects them from developing high BP and cardiovascular disease during the reproductive

period. However, the reason why men have higher BP remains unknown, although it could be due to nutritional and behavioural lifestyle factors.

Adults with abnormal WC are 31.6 times more likely to develop prehypertension compared to adults with normal WC (aOR = 31.65; 95% CI: 11.25, 89.02). This finding shows that abnormal WC is highly correlated with higher BP in men and women. A study among young adults in a university in South Africa yielded a 40.2% prevalence of prehypertension, and demonstrated that WC is significantly correlated with the presence of hypertension/prehypertension in both men and women, with values of r = 0.237 and r = 0.345.[22]

A study in China also demonstrated that abnormal WC increased the risk of prehypertension in both men and women. Men with WC greater than 94 cm but less than 102 cm have an increased risk of having prehypertension (aOR = 1.68 95% CI: 1.42, 2.01); the risk is nearly double in men with WC greater than 102 cm (aOR = 1.91 95% CI: 1.21, 3.00). The result is more significant in women, with those with WC greater than 80 cm but less than 88 cm having a risk of prehypertension more than two times greater than those with normal WC (aOR = 2.65 95% CI: 2.40, 2.93). Among women with WC greater than 88 cm, the chances are increased to more than five times greater (aOR = 5.14 95% CI: 4.48, 5.89).[23] A study performed among Mexican-American women found that 82% of participants with abdominal obesity had prehypertension, and the prehypertension prevalence among these women was higher (51%) than the combined prevalence of prehypertension and hypertension nationwide (43%).[24] WC is one of the indicators for abdominal obesity, and it is also a known risk factor for CVD.[7]

Adults with tobacco use had a higher prevalence of prehypertension (68.8%) than non-smokers (33.3%). Although this factor is not significantly associated with prehypertension, the impact of health of smokers among the population is important. Smoking can be associated with many chronic diseases, particularly cardiovascular-related disease. The results from the data analysis in the present study showed a much higher percentage of smokers with prehypertension compared to the rates of 8.1%[14] and 29%[25] observed in previous studies. However, smoking itself is more common among male adults. From our data, the majority of the respondents were women (62.9%). This factor could explain why smoking is not significantly associated with prehypertension in this study.

Occupation, educational level, family history of hypertension, smoking status, and BMI were not significantly associated with prehypertension in the present study.

Conclusion

The prevalence of prehypertension among adults visiting an outpatient clinic in the present study was 37.1%. This study demonstrated that age, sex, and abnormal WC are predictors for prehypertension.

Limitations

The current study was limited because of its cross-sectional design, which is prone to a non-response bias. This study also represents adults in a small population. Furthermore, the results from this study are based on the BP readings obtained from three repeated measurements during one single visit. Based on current recommendations,[8] the BP should be taken during two independent clinic visits. However, owing to limitations in study time and logistics, BP was only measured during a single clinic visit. Nevertheless, other studies have shown that with a single clinic visit, the prevalence can be overestimated by 3%−29%.[26] The present study also has some limitations related to CVD risk factors. Blood tests such as lipids, fasting plasma glucose, and HbA1c measurements were not performed in this study.

Recommendations

Considering that age is a significant factor associated with prehypertension, and the mean age of patients with prehypertension is less than 40 years old, lifestyle modifications must be implemented earlier to prevent the development of hypertension, which can lead to cardiovascular risk. Based on the Framingham Heart Study population, the participants were followed up for 4 years to examine the progression of prehypertension to hypertension. It was found that 27% of the patients developed hypertension after 4 years.[27] In light of these results, participants in the current study with prehypertensive BP were advised to check their BP status at least once a year to detect early development of hypertension.

Obesity as a major modifiable risk factor detected in this study is preventable, and significant effort should be invested to prevent this from increasing further in order to reduce the incidence of cardiometabolic effects and mortality. Adults with overweight and obesity must be referred for weight loss management to reduce their weight and counselling regarding a healthy lifestyle.

We have recommended community-based programs targeting individuals aged 40 years and above, especially men and those with abnormal WC, in order to reduce the risk of hypertension and other CVDs. For example a continuous educational programme on prehypertension should be facilitated to increase awareness about the importance of regular BP screening and identifying one's risks of developing hypertension and CVD at an early stage.

Other indices for CVD risk factors such as blood tests for lipids, fasting plasma glucose, and HbA1c are recommended to be included in future research.

Conflict of interest

All authors have no conflict of interest to declare.

Ethical approval

Ethical approval was obtained from the Research and Ethical Committee, School of Medical Sciences, USM Health Campus on 30 March 2015 (JEPeM CODE: USM/JEPeM/14090304).

Authors' contributions

Acknowledgement

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