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

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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.
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. “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.³

The overall prevalence of prehypertension in Malaysia is 37.1%,⁴ a rate higher than the prevalence of hypertension itself. Two local studies showed prevalence rates of prehypertension among undergraduate university students of 42.9%⁵ and 30.1%,⁶ 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 prehypertension developed stage I 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.

Conclusion: In this study, the prevalence rate of prehypertension 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; Prehypertension; Prevalence; Waist circumference

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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 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).

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.

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.

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/m²), normal weight (18.5–22.9 kg/m²), overweight (23–27.4 kg/m²), obesity (≥27.5 kg/m²). 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).

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.
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 < 0.05) 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%) and higher than the rate reported in China (21.9%). 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. In Vietnam, the percentage of adults with prehypertension was higher (41.8%), particularly in comparison to the prevalence of hypertension (20.7%).

The national prevalence of prehypertension in Malaysia according to the Third National Health and Morbidity Survey (NHMS 3) was 37%. Overall in Malaysia, the prevalence of prehypertension is in the range of 34%—37%. 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% and 30.1%, respectively. 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. 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). 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). Two studies in India reported a significantly increased prevalence of prehypertension and hypertension among men and older individuals. 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
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.

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, 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%. 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. 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.

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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**

SBI presented the idea and reviewed the research proposal with RNZ. NHR designed the study, conducted the research, provided research materials, and collected and organized data with supervision from SBI and RNZ. NHR analysed and interpreted data and wrote the initial article supervised by SBI and RNZ. RNZ, NHR, and RDM wrote the final draft of the article. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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**References**

1. Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. JAMA 2003; 289(19): 2560–2571.

2. National Heart L, and Blood Institute. Incidence and prevalence: 2012 chart book on cardiovascular and Lung diseases. National Institutes of Health; 2012. https://www.nhlbi.nih.gov/files/docs/research/2012_ChartBook_508.pdf.

3. Chia Y. Prehypertension: what is the current status? Malays Fam Physician 2008; 3(2): 72.

4. Lee YOT, Muna S, Alwi SS, Kamarudin KK. Do university students have high cardiovascular Risk? A pilot study from Universiti Malaysia Sarawak (UNIMAS). Malays Fam Physician 2010; 5: 1985–2274.

5. Balami A, Salmiah M, Nor Afiah M. Psychological determinants of prehypertension among first year undergraduate students in a public university in Malaysia. Malaysian J Pub Health Med 2014; 14(2): 67–76.

6. Julius S, Nesbitt SD, Egan BM, Weber MA, Michelson EL, Kaciroti N, et al. Feasibility of treating prehypertension with an angiotensin-receptor blocker. N Engl J Med 2006; 354(16): 1685–1697.

7. Disease Control Division MOH. Malaysia NCD Surveillance 2006: NCD Risk Factors in Malaysia 2006. http://iku.gov.my/ index.php/research-eng/list-of-research-eng/iku-eng/nhms-eng/ nhms-2006-eng [accessed 13 March 2016].

8. Ministry of Health. Malaysian clinical practice guideline: management of hypertension. 4th ed. Ministry of Health; 2013.

9. Raihan K, Azmawati M. Cigarette smoking and cardiovascular risk factor among male youth population. Malaysian J Pub Health Med 2013; 13(1): 28–36.

10. Zhang Y, Lee ET, Devereux RB, Yeh J, Best LG, Fabsitz RR, et al. Prehypertension, diabetes, and cardiovascular disease risk in a population-based sample the Strong Heart Study. Hypertension 2006; 47(3): 410–414.

11. He J, Neal B, Gu D, Suriyawongpaisal P, Xiu X, Reynolds R, et al. International collaborative study of cardiovascular disease in Asia: design, rationale, and preliminary results. Ethn Dis 2004; 14(2): 260–268.

12. Widyaja FF, Santosuo LA, Barus NRV, Pradana GA, Estetika C. Prehypertension and hypertension among young Indonesian adults at a primary health care in a rural area. Med J Indonesia 2013; 22(1): 39–45.

13. Do HT, Geleinjse JM, Le MB, Kok FJ, Feskens EJ. National prevalence and associated risk factors of hypertension and prehypertension among Vietnamese adults. Am J Hypertens 2015; 28(1): 89–97.

14. Iqitiz MH, Salmiah M, Saliluddin S. Pre-hypertension and its associated factors among students in a pre-university college in Malaysia. Inter J of Pub Health and Clin Sci 2016; 3(5): 70–85.

15. Al-Maqbali AA, Temple-Smith M, Ferler J, Blackberg J. Prevalence and determinants of pre-hypertension among Oman adults attending non-communicable disease screening program in primary care setting in Sohar city. Oman Med J 2013; 28(5): 316–323.

16. Wang Y, Wang QJ. The prevalence of prehypertension and hypertension among US adults according to the new joint national committee guidelines: new challenges of the old problem. Arch Intern Med 2004; 164(19): 2126–2134.

17. Srinivas S, Satyavaraprasad K, Ramdas R, Krishna C, Tajuddin T, Rao RP. Prevalence of prehypertension in adult population of rural Andhra Pradesh. Asian J Biomed Pharm Sci 2013; 3(23): 45–48.

18. Nasir NM, Daher AM, Ramli AS, Krishnapillai ADS, Miskan M, Yasin MM, et al. 674 cardiovascular risk factors associated with prehypertension in Malaysian adults. J Hypertension 2012; 30: e195–e196.

19. Grotto I, Grossman E, Huerta M, Sharabi Y. Prevalence of prehypertension and associated cardiovascular risk profiles among young Israeli adults. Hypertension 2006; 48(2): 254–259.

20. Mohan V, Deepa M, Farooq S, Datta M, Deepa R. Prevalence, awareness and control of hypertension in Chennai-the Chennai urban rural epidemiology study (CURES–52). J Assoc Phys India 2007; 55: 326–332.

21. Yadav S, Boddula R, Genitta G, Bhatia V, Bansal B, Kongara S, et al. Prevalence & risk factors of prehypertension & hypertension in an affluent north Indian population. Indian J Med Res 2008; 128(6): 712.

22. Nkch-Chungag BN, Mxhosa TH, Mgoduka PN. Association of waist and hip circumferences with the presence of hypertension and pre-hypertension in young South African adults. Afr Health Sci 2015; 15(3): 908–916.

23. Deng W-W, Wang J, Liu M-M, Wang D, Zhao Y, Liu Y-Q, et al. Body mass index compared with abdominal obesity indicators in relation to prehypertension and hypertension in adults: the CHPSNE study. Am J Hypertens 2013; 26(1): 58–67.

24. Aguirre TKA, Tovar. A relationships among hypertension, waist circumference, and body composition in a rural Mexican American population. J Family Med Community Health 2015; 27(7): 1057.

25. Al-Naggar RA, Al-Dubai SAR, Hamoud T, Chen R, Al-Jashamy K. Prevalence and associated factors of smoking among Malaysian university students. Asian Pac J Cancer Prev 2011; 12: 619–624.

26. He J, Gu D, Chen J, Wu X, Kelly TN, Huang J-f, et al. Premature deaths attributable to blood pressure in China: a prospective cohort study. Lancet 2009; 374(9703): 1765–1772.

27. Vasan RS, Larson MG, Leip EP, Kannel WB, Levy D. Assessment of frequency of progression to hypertension in nonhypertensive participants in the Framingham Heart Study: a cohort study. Lancet 2001; 358(9294): 1682–1686.