

# Prevalence and Determinants of Pre-Hypertension among Undergraduate Preclinical Medical Students in Central Malaysia

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## ABSTRACT

**Introduction:** Pre-hypertension, a classification of blood pressure ranging from 120-139 mm Hg systolic and/or 80-89 mm Hg diastolic, has been introduced to identify those high-risk group of developing hypertension to implement early intervention to halt disease progression. This study determines the prevalence of pre-hypertension and its determinants among undergraduate preclinical medical students in Malaysia. **Materials & Methods:** This was a cross-sectional study conducted among 158 registered second year medical students at one research university in central Malaysia from January to April 2018. **Results:** The prevalence of pre-hypertension was 20.6% among undergraduate preclinical medical students. The most respondent was female (69.9%), Malay ethnic (50.6%) who had normal body mass index (67.3%), no depression (79.5%), no anxiety (60.3%), no stress (68.6%), low physical activity level (44.9%), never smoked (95.5%), and never consumed alcohol (87.8%). Some respondents had positive family history of hypertension (43.6%) and diabetes mellitus (31.4%). After adjusted for all variables, gender (AOR=14.45, 95% CI 5.58-37.43) and depression status (AOR=6.37, 95% CI 1.29-31.49) were significantly associated with pre-hypertension. **Conclusion:** The prevalence of pre-hypertension among preclinical medical students was lower compared to other country, predicted by gender and depression status. However, further comprehensive multicentered studies in Malaysia with larger sample size is recommended to get more precise results in identifying determinants for pre-hypertension so that early intervention could be implemented nationwide.

**KEYWORDS:** Pre-hypertension, determinant, medical student, Malaysia

## INTRODUCTION

Hypertension is a well known predictors of cardiovascular and cerebrovascular disease<sup>1</sup> which are among the major cause of death in Malaysia.<sup>2</sup> Hypertension and its complications such as myocardial infarction, stroke, renal failure, and premature death are common medical conditions seen in primary healthcare<sup>3</sup> and hospital setting.<sup>2</sup> Globally, one-third of population had been affected.<sup>4</sup> Similar evidence was recorded in Malaysia national survey which showed that one in three

Malaysian adult had hypertension.<sup>5</sup> However, despite health education and health awareness given by various agencies, the number of undiagnosed hypertension among 18 years old and above is still on the rising trend.<sup>5</sup>

In 2003, a new classification that includes the term 'pre-hypertension' has been introduced by the 7<sup>th</sup> Joint National Committee on Prevention, Detection, Evaluation and Treatment of Hypertension, which is defined as blood pressure (BP) ranging from 120-139 mm Hg systolic and/or 80-89 mm Hg diastolic.<sup>6</sup> Individual with pre-hypertension is at two- to threefold higher risk of developing hypertension as compared to optimal BP individual.<sup>7</sup> A cohort study published in 2001 revealed a conversion rate of 37%<sup>8</sup> while another study found higher conversion rate.<sup>9</sup> The differences in conversion rates may be attributed to study

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duration, baseline BP and sociodemographic profiles.<sup>7</sup> The rationale for highlighting this new category of 'pre-hypertension' is to emphasize on the cardiovascular risk associated with BP in this range and to increase public health awareness on the preventive action.<sup>10</sup> It was found that early identification of pre-hypertensive people and early intervention by adoption of healthy lifestyle could reduce the rate of progression to hypertension.<sup>11</sup>

Besides, it was found that hypertension is 'getting younger', which means that more younger people has been diagnosed with hypertension. The prevalence of pre-hypertension itself was found to be higher than hypertension among youth.<sup>12</sup> Among Indian undergraduate medical students, the prevalence of pre-hypertension was ranging from 37.45% to 68.38%<sup>13-15</sup> and in Middle East, was 13.5% to 47.4%.<sup>16-18</sup> Among university students in ASEAN country, the overall prevalence of pre-hypertension was 19%.<sup>19</sup> In Malaysia, the prevalence of pre-hypertension among youth, particularly undergraduate students is ranging from 11.5% to 34.2%.<sup>20-21</sup>

The development of hypertension is due to multifactorial reasons that can be divided into modifiable and non modifiable factors.<sup>10,22</sup> Modifiable factors includes dyslipidaemia, cigarette smoking, central obesity, microalbuminuria/proteinuria and family history of premature cardiovascular disease. The risk is higher for individual with higher baseline BP, increasing age and obesity. Furthermore, the impact of treating patient with hypertension would result with much higher cost compared to early management of pre-hypertension.<sup>23</sup> Thus, it is important to detect pre-hypertension among youth so that early intervention could be implemented to reduce the progression to hypertension. The aim of this study was to determine the prevalence of pre-hypertension and its determinants among second year medical students at a research university in central Malaysia.

## **METHODOLOGY**

### ***Study design and population***

This was a cross sectional study conducted from January to April 2018 at one research university in central Malaysia. Based on previous studies among comparable population in Malaysia, the prevalence

of pre-hypertension range 11.5% to 34.2%.<sup>20-21</sup> Thus, the required sample size for precision of 0.05 based on previous prevalence studies ranged between 157 to 346. We decided to employ a total 158 registered second year medical students, which met the minimum number of required sample size. We did not include the clinical medical students due to bureaucracy limitation in approaching them in the wards setting.

Moreover, during study period, some of them had been posted to district hospital and community setting which were not feasible for data collection in our limited capacity. On the other hand, the first year medical students were newly-enrolled, and still adapting with the study environment as medical students. Thus, we decided not to involve them as their adaptation process may confound the study outcome.

### ***Operational definition***

In this study, pre-hypertension was defined as BP reading ranging from 120-139 mm Hg systolic and/or 80-89 mm Hg diastolic.<sup>6</sup> Those respondents with systolic and diastolic less than 120 mm Hg and 80 mm Hg, respectively were classified as normal BP; while those with systolic and/or diastolic more than 139 mm Hg and/or 89 mm Hg, respectively were categorized as hypertension.<sup>6</sup> For body mass index (BMI), the cut-off points for overweight and obesity were 25 kg/m<sup>2</sup> and 30 kg/m<sup>2</sup>, respectively; while those with BMI less than 18.5 kg/m<sup>2</sup> were classified as underweight.<sup>24</sup>

Depression, anxiety and stress status were initially classified to normal, mild, moderate, severe and extremely severe based on score from 21-Items Depression, Anxiety and Stress Scale (DASS-21).<sup>25</sup> In this study, normal level of depression, anxiety or stress were operationally defined as no depression or anxiety or stress, respectively. On the other hand, mild to extremely severe level of depression, anxiety or stress were collectively defined as having depression, anxiety or stress, respectively.

### ***Data collection***

Participation in the study was voluntary and participant can withdraw at any time. Data were collected by using self-administered questionnaires, calibrated weighing machine and calibrated Spirit CK

-101C Mercurial Desk Model Sphygmomanometer. Questionnaires include sociodemographic data (age, gender, ethnicity, parental income, parental education), health-related data (past medical history, comorbid, family history, depression, anxiety, stress) and lifestyle-related data (smoking, alcohol consumption, physical activity). Depression, anxiety and stress status were measured by using Malay version of DASS-21<sup>26</sup> while level of physical activity was measured by using Malay version of short form International Physical Activity Questionnaire (IPAQ).<sup>27</sup> Anthropometry and BP were measured by trained personnel. BP was measured according to American Heart Association (AHA) recommendation in sitting position twice at intervals of 1 minute, and the average results was used to represent respondents' BP.<sup>28</sup> Before measurement, the positioning, cuff size selection, and brief explanation on the procedure were given to the respondents<sup>28</sup>. The respondents had been instructed not to talk or move during BP measurement.<sup>28</sup>

### Data analysis

Data was analyzed by using SPSS version 21. Descriptive analysis were performed and presented as frequencies and percentages. Simple logistic regressions were performed to test the association of socio-demographic, health-related and lifestyle-related factors with pre-hypertension. Data were presented as crude odds ratio (OR) and p-value. Multiple logistic regression analysis were conducted to identify determinants of pre-hypertension among respondents. All independent variables were initially included and elimination was done by backward stepwise likelihood ratio (LR) test. Test for interaction and detection for multicollinearity was done. Next, Hosmer-Lemeshow goodness-of-fit test was conducted to assess the model fitting. Data were presented as adjusted OR (AOR) and p-value. Significant level for all relevant test was set at  $p < 0.05$ .

### RESULTS

Out of 158 registered second year medical students, 156 of them voluntarily participated in this study which given the response rate of 98.73%. Table 1 showed respondents' characteristic. Majority of them were female (69.9%), Malay (50.6%), B40 parental income group (46.2%), normal BMI (67.3%), no depression (79.5%), no anxiety (60.3%), no stress

(68.6%), low physical activity level (44.9%), never smoked (95.5%) and never consumed alcohol (87.8%).

Only one out of 156 respondents was known to have hypertension, and thus was excluded from bivariable and multivariable analysis. Prevalence of pre-hypertension among these 155 respondents with no known hypertensive status was 20.6%.

Table 1: Respondents' characteristic

Variables (N=156)	Frequency (n)	Percentage (%)	Mean (SD)
<b>Age, years (min 18; max 21)</b>			19.9 (0.6)
<b>Gender</b>			
Male	47	30.1	
Female	109	69.9	
<b>Ethnic</b>			
Malay	79	50.6	
Chinese	36	23.1	
Indian	34	21.8	
Others	7	4.5	
<b>Parental Income</b>			
B40 (<RM3860)	72	46.2	
M40(RM3860-RM8319)	55	35.3	
T20 (>RM8319)	29	18.6	
<b>Hypertensive Status</b>			
Unknown hypertensive status	155		
Known hypertension <sup>a</sup>	1		
<b>Blood Pressure (n=155)<sup>b</sup></b>			
Normal	123	79.4	
Pre-hypertension	32	20.6	
<b>Body Mass Index, kg/m<sup>2</sup> (min 13.5; max 39.1)</b>			22.5 (4.1)
Underweight	18	11.5	
Normal	105	67.3	
Overweight	20	12.8	
Obese	13	8.3	
<b>Family History of Hypertension</b>			
Yes	68	43.6	
No	88	56.4	
<b>Depression Status</b>			
Normal (No depression)	124	79.5	
Mild - Moderate	24	15.4	
Severe - Very Severe	8	5.1	
<b>Anxiety Status</b>			
Normal (No anxiety)	94	60.3	
Mild - Moderate	38	24.4	
Severe - Very Severe	24	15.4	
<b>Stress Status</b>			
Normal (No stress)	107	68.6	
Mild - Moderate	44	28.2	
Severe - Very Severe	5	3.2	

Variables (N = 156)	Frequency (n)	Percentage (%)	Mean (SD)
<b>Level of Physical Activity</b>			
Low	70	44.9	
Moderate	52	33.3	
High	34	21.8	
<b>Smoking Status</b>			
Ever smoked	7	4.5	
Never smoked	149	95.5	
<b>Alcohol Consumption Status</b>			
Ever consumed alcohol	19	12.2	
Never consumed alcohol	137	87.8	

Abbreviation: SD Standard deviation; B40 Below 40%; M40 Middle 40%; T20 Top 20%

<sup>a</sup> excluded from logistic regression analysis

<sup>b</sup> excluded one respondent who was known to have hypertension

Table 2 showed distribution of pre-hypertension among respondents based on factors. Proportion of pre-hypertension in the respective group was higher among male (51.1%), non-Malay (23.4%), above-normal BMI (33.1%), no family history of hypertension (22.7%), had family history of diabetes mellitus (28.6%), severe-very severe depressive level (25.0%), no anxiety (28.7%), no stress (23.6%), high physical activity level (29.4%), ever smoked (57.1%) and ever consumed alcohol (31.6%).

Table 3 showed the factors associated with pre-hypertension among respondents using simple logistic regression and subsequently were run in multiple logistic regression to determine the determinants for pre-hypertension. There were no interaction and multicollinearity detected. The Hosmer-Lemeshow goodness-of-fit test showed that the model fits well. The model could predict 87.7% of those that will develop pre-hypertension correctly.

**Table 2:** Distribution of pre-hypertension among respondents

Variables (N = 155) <sup>a</sup>	Blood Pressure Classification		
	Normal, n (%)	Pre-hypertension, n (%)	
<b>Gender</b>	Male	23 (48.9)	24 (51.1)
	Female	100 (92.6)	8 (7.4)
<b>Ethnic</b>	Malay	64 (82.1)	14 (17.9)
	Non-Malay	59 (76.6)	18 (23.4)
<b>Body Mass Index</b>	Below Normal	17 (94.4)	1 (5.6)
	Normal	84 (80.8)	20 (19.2)
	Above Normal	22 (66.7)	11 (33.3)
<b>Family History of Hypertension</b>	Yes	55 (82.1)	12 (17.9)
	No	68 (77.3)	20 (22.7)
<b>Family History of Diabetes Mellitus</b>	Yes	35 (71.4)	14 (28.6)
	No	88 (83.0)	18 (17.0)
<b>Depression Status</b>	Normal (No depression)	93 (75.6)	30 (24.4)
	Mild-moderate	24 (100.0)	0 (0.0)
	Severe-very severe	6 (75.0)	2 (25.0)
<b>Anxiety Status</b>	Normal (No anxiety)	67 (71.3)	27 (28.7)
	Mild-moderate	33 (89.2)	4 (10.8)
	Severe-very severe	23 (95.8)	1 (4.2)
<b>Stress Status</b>	Normal (No stress)	81 (76.4)	25 (23.6)
	Mild-moderate	37 (84.1)	7 (15.9)
	Severe-very severe	5 (100.0)	0 (0.0)
<b>Level of Physical Activity</b>	Low	59 (84.3)	11 (15.7)
	Moderate	40 (78.4)	11 (21.6)
	High	24 (70.6)	10 (29.4)
<b>History of Smoking</b>	Ever smoke	3 (42.9)	4 (57.1)
	Never smoke	120 (81.1)	28 (18.9)
<b>History of Alcohol Consumption</b>	Ever drinks	13 (68.4)	6 (31.6)
	Never drinks	110 (80.9)	26 (19.1)

<sup>a</sup> Excluding one known case of hypertension from total respondents of 156

**Table 3:** Factors associated with pre-hypertension among respondents \*

Variables (N = 155)	SIMPLE LOGISTIC REGRESSION		MULTIPLE LOGISTIC REGRESSION		
	Crude OR	P-value <sup>b</sup>	Adjusted OR <sup>a</sup>	P-value <sup>b</sup>	95% CI
<b>Gender</b>					
Male	13.043	<0.001*	14.446	<0.001*	5.576 , 37.426
Female	Ref.		Ref.		
<b>Ethnic</b>					
Malay	Ref.				
Non-Malay	1.395	0.405			
<b>Body Mass Index</b>					
Below Normal	Ref.				
Normal	4.048	0.187			
Above Normal	8.500	0.050			
<b>Family Income</b>					
B40	Ref.				
M40	1.372	0.230			
T20	1.873	0.487			
<b>Family History of Hypertension</b>					
Yes	Ref.				
No	1.348	0.464			
<b>Depression Status</b>					
Normal (No depression)	4.839	0.038*	6.370	0.008*	1.289 , 31.486
Abnormal	Ref.		Ref.		
<b>Anxiety Status</b>					
Normal (No anxiety)	4.513	0.004*			
Abnormal	Ref.				
<b>Stress Status</b>					
Normal (No stress)	1.852	0.188			
Abnormal	Ref.				
<b>Level of Physical Activity</b>					
Low	Ref.				
Moderate	2.235	0.107			
High	1.475	0.411			
<b>History of Smoking</b>					
Ever Smoke	5.714	0.028*			
Never Smoked	Ref.				
<b>History of Alcohol Consumption</b>					
Ever drink	1.953	0.215			
Never drink	Ref.				

Nagelkerke R Square: 0.377

<sup>a</sup> Only significant adjusted OR (AOR) were presented<sup>b</sup> Statistical significance at p<0.05

\* p&lt;0.05

## DISCUSSION

The prevalence of pre-hypertension among preclinical medical students in this study was 20.6%. This was lower compared to study done among undergraduates in Malaysia in 2014.<sup>21</sup> This might due to the different in the sample size and reference population. Comparing with study done among undergraduates in other countries, the prevalence in this study was also lower.<sup>17-18</sup> Underdiagnosis of pre-hypertension in Malaysia

could be one of the reason as the number has been on the rise.<sup>5</sup> However, the prevalence was higher when comparing with other Asian country.<sup>29</sup> Coincide with the increased number of obesity among Malaysia population and the sedentary lifestyle practice nowadays, this figure alarms the nation as it can further predispose to hypertension. Awareness among them is crucial as this youngsters will grew up and lead the future generation.

Respondents in this study which were the university students with mean age of 19.9 years could represent the youth of educated population in Malaysia. The mean age was comparable with other study done in Malaysia and the prevalence was actually reflect the decreasing number of pre-hypertension among the youth.<sup>21</sup> Continuous health promotion and healthy activities organized by the Ministry of Health and private agencies must be sustainable to reduce the number further. On the other hand, early recognition and detection of pre-hypertension by health screening should be done to reveal the exact data or number of pre-hypertensive population for intensive intervention.

Besides that, this study showed that the proportion of pre-hypertension was significantly higher among male compared to female; male significantly had 14 times higher odds to have pre-hypertension as compared to female. This results concordance with other studies done among university students.<sup>17,21,29</sup> The plausible explanation on this issue was supported by the gender difference in terms of hormonal activity e.g. estrogen hormone and metabolic rate at early age.<sup>30-31</sup> A study by Everett and Zajacova (2015) among young adults found that gender differences in hypertension status was revealed at the age of as early as twenties, and female had higher hypertensive awareness contributed by higher healthcare use as compared to male.<sup>32</sup>

Other determinant in this study was depression status. In this study, those respondents with depression significantly had lower odds of having pre-hypertension. This result was contrast to the findings by other study which showed significant positive association between depression and pre-hypertension.<sup>21,33</sup> However, there were studies that observed a significantly lower BP among depressive respondents,<sup>34-36</sup> while another study among undergraduates student in one of the Asian country showed non-significant results.<sup>26</sup> The possible explanation for lower BP among depressed respondents is the central monoamine system through alteration of neuropeptide Y as common factor in characterizing depressive symptoms, suppressing sympathetic activity and decrease BP.<sup>37-38</sup> This could also be due to low sample size, and thus low study power.

The decision to conduct this study among medical students was not baseless; it was one of the strategy to combat hypertension as early as possible. As future health professionals or specifically medical doctors, maintaining good health status and early management of pre-disease state is crucial. This study revealed that 20.6% prevalence of pre-hypertension, and indirectly found that prevalence of depression, anxiety and stress were 20.5%, 39.8%, and 31.4% respectively. Although these numbers seem to be small, it could increase when the stressor become higher in clinical years or housemanship training. Early intervention, for example self-resilient, may be required as nation need to have healthy doctors as role-model for their patients and community.

There were several limitations in this study. Due to the design of cross sectional, this study unable to detect temporal relationship or causality between the determinants and the outcome. For example, our study showed that depression status significantly determined pre-hypertension, however we cannot deduce the cause-effect relationship. Furthermore, although sample size met the calculated minimum requirement, it was the smallest that might limit the possibilities of detecting the significant difference results of certain determinants, and evident through wide confidence interval of our multivariable analysis.

## CONCLUSION

In conclusion, the prevalence of pre-hypertension among undergraduates medical students was lower compared to other country, and gender and depression were the determinants. Since pre-hypertension is an alarming pre-disease state nowadays especially among younger age group, early detection and screening at the age of 18 years is crucial as part of preventive intervention for hypertension. Prevention and control by collaboration between various sectors including parents are needed to promote healthy lifestyle for combating this disease. A further comprehensive multicenter studies in Malaysia should be conducted to get better understanding and precision in identifying risk factors for pre-hypertension so that early intervention could be implemented nationwide.

## COMPETING INTEREST

There is no conflict of interest.

## ACKNOWLEDGEMENTS

The authors wish to thank Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia and second year medical students of the study location for providing us cooperation to ensure success of this study.

## FUNDING SOURCE

None

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