ORIGINAL ARTICLE

Hypertension and its association with Anthropometric indices among students in a public university

Cheah WL, Majorie Ensayan J, Helmy H, Chang CT

Cheah WL, Majorie Ensayan J, Helmy H, et al. Hypertension and its association with Anthropometric indices among students in a public university. *Malays Fam Physician.* 2018;13(1);2–9.

Keywords:
Hypertension, young adults, anthropometric indexes

Authors:

Cheah Whye Lian
(Corresponding author)
PhD
Department of Community Medicine and Public Health, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak Malaysia.
Email: wlcheah@unimas.my

Majorie Ensayan Junting
MPH
Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia.
Email: majoriensayan@yahoo.com

Helmy Hazmi
MComMed
Department of Community Medicine and Public Health, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak Malaysia.
Email: hhelmy@unimas.my

Abstract

Introduction: The present study aimed to determine the prevalence of hypertension and its association with nutritional status (body mass index, body fat percentage, and visceral fat) among students in a public university in Sarawak, Malaysia.

Methods: This was a cross-sectional study among undergraduate students aged 18 years old and above. Anthropometric measurements, such as weight, height, body composition, and blood pressure measurements, were collected. Hypertension was defined as equal or more than 140/90 mmHg. Statistical analyses were done using IBM SPSS version 20.

Results: A total of 354 respondents participated in the study. Mean age for the respondents was 21 years (SD 1.18 years). About 40% of the respondents were overweight or obese. Prevalence of hypertension was 8.2%. Mean systolic blood pressure was 119.1mmHg (SD14.36mmHg), and the mean diastolic blood pressure was 72.6mmHg (SD 9.73mmHg). There is a significant association between male gender (odds ratio =3.519, 95% CI is 1.886-6.566), body fat percentage (odds ratio =1.944, 95% CI is 1.050-3.601), visceral fat (odds ratio = 2.830, 95% CI is 1.346-5.951), and family history of hypertension (odds ratio= 2.366, 95% CI is 1.334-4.194) and hypertension.

Conclusion: The prevalence of hypertension was less than 10% and is associated with male gender, body composition, and family history of hypertension.

Introduction

Hypertension is one of the leading causes of disability and death. Globally, in 2014, the prevalence of hypertension in adults was approximately 22%.[1] Men are known to have a slightly higher prevalence of hypertension (21%) as compared to women (16%) in all World Health Organization (WHO) regions.[1] According to the WHO, the age-standardized prevalence of hypertension in adults 18 years and above in Malaysia is 19.6%.[1] Hypertension is well known for being one of the most common risk factors for heart attack and stroke.[2] According to the Malaysian Ministry of Health,[3] in 2013, when considering ischemic heart disease at Ministry of Health Hospitals, the death rate specific to angina pectoris was 1.99 per 100,000 population, and acute myocardial infarction contributed 4.20 deaths per 100,000 population. Due to ill health, the burden of the disease not only impairs a person's capability and productivity, but indirectly leads to smaller economic growth of the country. Therefore, hypertension affecting a large number of patients in Malaysia creates an economic burden on the health care budget and the nation's economy.[4]

With the presence of risk factors, such as high salt consumption, habitual alcohol intake, sedentary lifestyle, ageing, and stressful life events, which may occur concurrently and act synergistically, individuals may have a higher chance of developing hypertension. This health issue not only affects older adults, but also those who are younger since most people who develop hypertension at an early stage are asymptomatic. A local study by Cheah et al.[5] demonstrated that 7.3% of pre-university students were at risk of hypertension; these were predominantly males. Similar studies carried out in other countries reported a prevalence of hypertension of 7.5-9.3% among university students students.[6,7,8] The study by Cheah et al.[5] further suggested that there was a positive relationship between being overweight or obese and the development of hypertension, in which

Chang Ching Thon
PhD
Deparment of Nursing, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia.
Email: chingthon@gmail.com

those who were overweight, with an unhealthy waist circumference and waist-to-hip ratio, high conicity index, and overfat (unhealthy body fat) were more prone to hypertension, as visceral fat depots are theorised to secrete free fatty acids and proinflammatory cytokines. This is further supported by Mehdad et al.[8], i.e., that an increase in body mass index is associated with a greater risk of developing hypertension. Similarly, a higher prevalence of hypertension was found among those with higher percentages of body fat, the chief standard determinant of obesity.[9] An excess of body fat, particularly abdominal fat, is linked to cardiometabolic morbidity.[10]

Early identification of risk factors in hypertension, measured by anthropometric indices, can be enhanced in relatively easy and cost effective ways in a local setting. Hence, from this point, intervention can be carried out effectively to reduce disease burden. This study aimed to determine hypertension and its association with anthropometric indices among students in a public university in Kota Samarahan, Sarawak, Malaysia.

Methods

This was a cross-sectional study of university students at the University of Malaysia, Sarawak (UNIMAS) carried out from September 2015 until July 2016. The University of Malaysia, Sarawak (UNIMAS) is the eighth university in Malaysia, and the first public and largest university in Sarawak, located in Kota Samarahan, 25 km from the capital city of Sarawak. At the time of the data collection, there were eight faculties at UNIMAS.

The sample size was calculated based on the highest sample size needed for the research objectives. Using OpenEpi version 3.03a, with a sampling frame of 14,500 students, a prevalence of hypertension of 32.7%[12], and an attrition rate of 10%, a minimum total sample of 364 respondents were needed for this study. Multistage cluster sampling was carried out. Three schools were selected from each of the arts and sciences based discipline, followed by a random selection of cohorts (year, program). Everyone within the chosen cohort was sampled. The inclusion criteria were students who were 18 years and above who had given their consent to participant. Students who were younger than 18 years of age, wheelchair bound, pregnant (for females), and previously diagnosed with hypertension were excluded from this study.

Socio-demographic profile, family history of hypertension, and programme enrolled in at UNIMAS were collected through a questionnaire. Anthropometric measurements, such as height, were taken using an SECA 213 stadiometer. Weight and body composition (visceral and body fat) were measured using an Omron Model HBF-375 Karada Scan. Three measurements were taken for each indicator, and the nearest two values (nearest to two decimal points) were averaged. Body Fat Percentage (BFP) was classified based on gender, where, for males, the categories were below 10% (Low), 10-19.9% (normal), and equal to or above 20% (high). In comparison to males, the %BFP cut-off points were below 20% (low), 20-22.9% (normal), and equal or greater than 30% (high) for females.[13] Classification of visceral fat was based on manual operation of OMRON Healthcare with ranges of 0.5-9.5 (Normal), 10-14 (High), and 15 and above (very high). Body mass index (BMI) (kg/m^2) was calculated and classified according to the Clinical Practice Guidelines on Management of Obesity,[14] where <18.5 kg/m^2 is underweight, 18.5-22.9 kg/m^2 is normal, 23-24.9 kg/m^2 is overweight, and ≥25 kg/m^2 is obese.

Blood pressure was measured twice using an Omron HBP-1100 Professional Portable blood pressure monitor. The two measurements of the blood pressure (BP) were taken within an interval of one minute as recommended in the Clinical Practice Guidelines on the Management of Hypertension.[12] If the difference in the BP was more than 5mmHg, one additional reading was taken, and the two readings closest in value (nearest to two decimal points) were used for data entry. The final reading used in analysis was based on the average of the two readings recorded. Calibration was done by selecting 10% of the respondents from each session, taking their BP with digital BP measurements, and calibrating with a manual sphygmomanometer. BP readings were then classified according to the Malaysian Clinical Practice Guidelines for Managements of Hypertension, Fourth Edition, in which hypertension is defined as equal to or more than 140/90 mmHg.[15]

All statistical analyses were performed using the IBM Statistical Package for Social Sciences (SPSS) version 20.0. In terms of descriptive data, percentage, frequency, mean ± standard

deviation (SD) were used. Data was cleaned and checked for normality before proceeding to inferential statistics. Selection of variables for univariate analysis before entering multivariate analysis was based on p value <0.20. Multiple logistic regression was performed to study the association of visceral fat, body fat, family history of hypertension, and gender with hypertension. For all analyses performed in the study, 95 % confidence intervals were used, and a p-value of less than 0.05 was considered to be statistically significant.

Ethical approval was obtained from the UNIMAS Medical Ethics Committee (UNIMAS/NC-21.02/03-02(92)). Approval to conduct the study was granted by the Vice-Chancellor of UNIMAS. Each participant was briefed on the study, and informed consent was obtained prior to data collection.

Results

A total of 354 respondents participated in this study, 80.5% of which were females. The mean ± SD for the age of respondents was 21.0 ±1.2 years. The main ethnic group was Malay (48.6%), and the majority of the respondents were from Sabah and Sarawak (53.7%). More than half of the participants were enrolled in an art-based programme (55.4%). Detailed socio-demographic characteristics of the respondents are presented in **Table 1**.

Table 1. Socio-demographic characteristics of respondents (n= 354)

	No.	%	mean ± SD
Gender			
Male	69	19.5	
Female	285	80.5	
Age			21.0 ±1.2
Race			
Malay	172	48.6	
Chinese	50	14.1	
Bumiputra Sarawak	72	20.3	
Bumiputra Sabah	38	10.7	
Other	22	6.2	
Place of origin			
Peninsular Malaysia	164	46.3	
Sabah & Sarawak	190	53.7	
Programme of study			
Art	196	55.4	
Science	158	44.6	

The mean ± SD of the BFP of the respondents was 27.5 ± 6.9, the median and inter-quartile range for visceral fat was 5.1 (IQR=4.6). Forty-three percent of the respondents had high or very high body fat; meanwhile, 13.8% of the respondents had high or very high visceral fat. In terms of BMI, the mean± SD was 23.3 ± 5.0 kg/m^2; however, the result shows that 40.7% (n=144) of the total respondents were classified as overweight or obese. Meanwhile, the mean± SD for systolic blood pressure was 119.1 ± 14.4 mmHg, and the mean± SD for diastolic blood pressure was 72.6 ± 9.7 mmHg. A total of 8.2% (n=29) of the respondents were found to be hypertensive, and approximately 31.1% of the total respondents were found to have a family history of hypertension (**Table 2**). **Table 3** shows the results of the univariate analysis between hypertension and various factors.

Table 2. Nutritional status and health profiles of the respondents (n= 354)

	No.	%	mean ± SD
Body fat (%)			27.5 ±6.9
Normal	202	57.0	
High & very high	152	43.0	
Visceral fat			5.1 ±4.6*
Normal	305	86.2	
High & very high	49	13.8	
Place of origin			23.3 ±5.0
Underweight	41	11.6	
Normal	169	47.7	
Overweight	41	11.6	
Obese	103	29.1	
Systolic blood pressure (mmHg)			119.1±14.4
Diastolic blood pressure (mmHg)			72.6 ±9.7
Hypertension	29	8.2**	
Family with history of hypertension	110	31.1	

* Inter-quartile range;
** 95% Confidence Interval (CI) of 1.05-1.11

Logistics regression was used to examine the association between visceral fat, body fat percentage, family history of hypertension, gender and hypertension. Table 4 shows the results of this analysis. The full model containing all predictors was statistically significant, χ^2 (4, 354) = 49.4, p<0.01, indicating that the model was able to distinguish between respondents who had normal blood pressure and those who were hypertensive. This model containing the four independent variables explained between 0.13 (Cox and Snell R- squared) and 0.20 (Nagelkerke R-squared) of the variability in hypertension. It was also able to classify 81.1% of the cases. Table 4 also shows that visceral fat, body fat, family history of hypertension, and gender had a significant association with hypertension. The odds ratio for visceral fat was 2.83, indicating that those with higher visceral fat values were almost 3 times more likely to be hypertensive. Meanwhile, the odds ratio for body fat was 1.94, indicating that those with higher body fat value were almost 2 times more likely to become hypertensive. In terms of the odds ratio for family history of hypertension, the value is 2.37, indicating that those with a family history of hypertension were more than 2 times more likely to become hypertensive. Finally, the odds ratio for male gender was 3.52, indicating that being male increases the likelihood of becoming hypertensive by almost 4 times.

Table 3. Association between hypertension and socio-demographic characteristics and health profile (n=354)

	Normal (n=278)	Hypertension (n=76)	P value
	No. %/mean ± SD		
Gender			27.5 ±6.9
Male	40 (14.4)	29 (38.2)	<0.01
Female	238 (85.6)	47 (61.8)	
Age (year)	20.9±1.19	21.3±1.1	0.06
Race			
Malay	133 (47.8)	39 (51.3)	
Chinese	39 (14.0)	11 (14.5)	
Bumiputra Sarawak	55 (19.8)	17 (22.4)	0.17
Bumiputra Sabah	29 (10.4)	9 (11.8)	
Others	22 (8.0)	0	
Place of Origin			
Peninsular Malaysia	135 (48.6)	29 (38.2)	0.12
Sabah & Sarawak	143 (51.4)	47 (61.8)	
Program of Study			
Art	151 (54.3)	45(59.2)	0.27
Science	127 (45.7)	31(40.8)	
Body fat (%)			
Normal	172 (61.9)	30 (39.5)	<0.01
High & very high	106 (38.1)	46 (60.5)	
Visceral fat			
Normal	254 (91.4)	51 (67.1)	<0.01
High & very high	24 (8.6)	25 (32.9)	
BMI (kg/m^2)			
Underweight	37 (13.3)	4 (5.3)	
Normal	143 (51.4)	26 (34.2)	<0.01
Overweight & Obese	98 (35.3)	46 (60.5)	
SBP, mm Hg	114.0±11.1	137.5±8.9	<0.01
DBP, mmHg	70.1±7.3	81.5±12.2	<0.01
With Family History			
Yes	76 (27.3)	34 (44.7)	<0.01
No	202 (72.7)	42 (55.3)	

Table 4. Logistic regression analysis for factors predicting hypertension

	B	S.E.	Wald	df	Sig	Exp(B)	95% C I for EXP (B)	
							Lower	Upper
Visceral fat	1.04	0.38	7.53	1	<0.01[a]	2.83	1.35	5.95
Body Fat	0.67	0.31	4.47	1	0.03[a]	1.94	1.05	3.60
Family History of Hypertension (ref=no family history of hypertension	0.86	0.29	8.68	1	<0.01[a]	2.37	1.33	4.19
Male (ref=female)	1.26	0.32	15.63	1	<0.01a	3.52	1.89	6.57

[a] Significant at p<0.05; S.E, standard errors; df, degrees of freedom; Significant p; EXP (B), odds ratio; 95% CI, 95% confidence interval

Discussion

The prevalence of hypertension in this study was 8.2% (n=29), which falls within the reported prevalence of 7.5-9.3%.[6,7,8] Compared to Cheah et al.'s[5] study in the same location, keeping in mind that Cheah et al. used younger participants (pre-university students), the prevalence of hypertension in this study was found to be higher. This finding indicates that age plays an important role in hypertension, in which aging is associated with the progressive loss of flow-mediated dilatation in the systemic arteries.

In terms of BMI, 40.7% of the respondents in this study were found to be overweight or obese. Based on the National Health and Morbidity Survey 2011,[12] the percentages of overweight and obese adults aged 18 years and above were 33.3% and 27.2%, respectively. The current study indicated a lower prevalence of being overweight and obesity among the undergraduate students, who are younger than the sample used for the national survey. The high percentages of overweight and obese students were associated with a high proportion of high or very high body fat (40.3%). This finding is alarming because the respondents of this study were aged between 18-22 years old, a young-adult population that should be healthier. However, the literature shows that such a phenomena is not uncommon as the younger generation tends to be less physically active with an increasing tendency to consume fast food; this is an escalating pandemic.[16]

The study also found that there is a significant association between hypertension and gender, body fat, visceral fat, and family history of hypertension. The finding whereby BFP and visceral fat have an association with hypertension was similar to the previous studies,[17] in which all the obesity-related indicators, such as BMI, visceral fat, and BFP, were factored into the analysis, and visceral fat and BFP remained independently associated with hypertension. This indicates that the fat in the body and within the organs play a more crucial role in the development of hypertension than body weight itself. The impact of excessive weight on the risk of developing essential hypertension has been well established, as indicated in the Framingham Heart Study, which suggests that obesity's contribution to hypertension was approximately 65% to 75%. Excessive weight is also associated with increases in regional blood flow, cardiac output, and arterial blood pressure.[18]

Respondents with a positive family history of hypertension also showed a significant association with hypertension. This finding was consistent with a local study that reported that individuals with a positive family history of hypertension are twice as likely to develop hypertension (aOR 1.96, CI 1.59-2.42).[19] Therefore, screening among family members, especially with a family history of hypertension, is vital in detecting those at risk. Hence, with early detection, intervention can prevent further deterioration of the condition.

Gender also contributed to the significant association towards hypertension. There was a greater proportion of males who were hypertensive compared to females; this was consistent with other studies.[5,20] This could be explained by the fact that hormones, such as testosterone, can play an important role in gender-associated differences in blood pressure regulation, as well as have a protective effect, such as oestrogen in females.[21] It was further explained by Celermajer et al.[22] that gender differences can affect the arterial physiology of a human being. Men tend to exhibit a gradual decline in endothelial responses after the age of 40, but a woman's vascular physiology remains normal for another 10 years beyond 40. However, once a woman reaches menopause, the rate of decline in endothelial responses will increase. Hence, women's risk of hypertension will eventually be the same as men's.

The study also showed that respondents with high body fat had odds of almost two times higher of being hypertensive compared to those without high body fat, whereas for respondents with high visceral fat, the odds were almost three times higher of being hypertensive. The detrimental effects of an excessive amount of visceral fat tissue, which cause increases in various cardio metabolic abnormalities independently from concurrent subcutaneous fat, indicate that visceral fat tissue could be a good marker for an increased risk of cardiovascular diseases.[23] In fact, both body fat and visceral fat were rated as better indicators for obesity than BMI. This is because a high proportion of muscle mass may overestimate the BMI, which explaines why Mullie et al.[24] recommended a combination of measurement methods, such as BMI and body composition, to reach a more accurate assessment.

Since this study was conducted using UNIMAS undergraduate students, generalization of result will be limited. Nevertheless, the variety of the respondents' places of origin reflects the involvement of all ethnic groups in Malaysia. As this was a cross-sectional study, it has the limitation in drawing conclusion between disease occurrence and risk factors.

In conclusion, the prevalence of respondents who were found to be hypertensive was 8.2%, with 40.7% classified as overweight or obese, 43.0% classified as having high or very high body fat, and 13.8% with high or very high visceral fat. Visceral fat class, body fat percentage, family history of hypertension, and gender were found to have significant association with hypertension. These findings indicate that earlier detection and intervention should be carried out as soon as possible within the university setting and among the general public. In order to increase awareness of hypertension and other health-related issues, more promotions can be carried out using electronic media and social media networking.

Competing Interests

The authors declare that they have no competing interests or any possible conflicts of interest regarding the publication of this paper.

Acknowledgements

The authors would like to thank the university and all the respondents for making this project successful.

How does this paper make a difference to general practice?

- Earlier screening should be carried out among younger adults to detect those who are hypertensive to ease disease burden.
- Anthropometric indices, which are relatively easy to conduct and cost-effective, can be used to facilitate the detection of hypertension, particularly in the public setting.

References

1. WHO. Global status report on noncommunicable diseases 2014. http://www.who.int/nmh/publications/ncd-status-report-2014/en; 2014 Accessed March 18, 2016.
2. Almgren T, Persson B, Wilhelmsen L, et al. Stroke and coronary heart disease in treated hypertension – a prospective cohort study over three decades. *J Intern Med*. 2005;257(6):496-502.
3. Ministry of Health Malaysia. Ministry of Health Annual Report, 2014. Kuala Lumpur, Malaysia: Ministry of Health Malaysia; 2014.
4. Alefan Q, Ibrahim MMI, Razak TA, et al. Cost effectiveness of antihypertensive treatment in Malaysia. *Malaysian Journal of Pharmaceutical Sciences*. 2009;7(2):137-152.
5. Cheah WL, Helmy H, Chia H, et al. Hypertension and its association with anthropometric indexes among pre-university students. *Int J Adolesc Med Health*. 2016;28(4):373-9.
6. Ibrahim NK, Mahnashi M, Al-Dhahri A, et al. Risk factors of coronary heart disease among medical students in King Abdulaziz University, Jeddah, Saudi Arabia. *BMC Public Health*. 2014;14(411). https://doi.org/10.1186/1471-2458-14-411.
7. Baig M, Gazzaz ZJ, Gari MA, et al. Prevalence of obesity and hypertension among University students and their knowledge and attitude towards risk factors of Cardiovascular Disease (CVD) in Jeddah, Saudi Arabia. *Pak J Med Sci*. 2015;31(4):816-820.
8. Tadesse T, Alemu H. Hypertension and associated factors among university students in Gondar, Ethiopia: A cross-sectional study. *BMC Public Health*. 2014;14(937). https://doi.org/10.1186/1471-2458-14-937.
9. Mehdad, S, Hamrani, A, Kari, KE, et al. Prevalence of elevated blood pressure and its relationship with fat mass, body mass index and waist circumference among a group of Moroccan overweight adolescents. *Obes Res Clin Pract*. 2013;7(4):e284-9.
10. Santos Silva, DA, Petroski, EL, Peres, MA. Is high body fat estimated by body mass index and waist circumference a predictor of hypertension in adults? A population-based study. *Nutr J*. 2012;11(1):112.
11. Bastien, M, Poirier, P, Lemieux, I, et al. Overview of epidemiology and contribution of obesity to cardiovascular disease. *Prog Cardiovasc Dis*. 2014;56(4):369-381.
12. Ministry of Health Malaysia. The National Health and Morbidity Survey 2011. Kuala Lumpur, Malaysia: Institute for Public Health, National Institutes of Health, Ministry of Health; 2011.

13. Wilmore JH, Buskirk ER, DiGirolamo M, et al. Body composition-a round table. *Phys Sportsmed*. 1986;14:144-162.

14. Ministry of Health Malaysia. Clinical Practice Guidelines on Management of Obesity 2004. Kuala Lumpur, Malaysia: Ministry of Health Malaysia; 2004.

15. Ministry of Health Malaysia. Clinical Practice Guidelines on Management of Hypertension 2013, 4th ed. Kuala Lumpur, Malaysia: Ministry of Health Malaysia; 2013.

16. Sabra AA, Taha AZ, Al-Sebiany AM. Coronary heart disease risk factors: Prevalence and behavior among male university students in Dammam city, Saudi Arabia. *J Egypt Public Health Assoc*. 2007;82:21–42.

17. Wang Z, Zeng X, Chen Z, et al. Association of visceral and total body fat with hypertension and prehypertension in a middle-aged Chinese population. *J Hypertens*. 2015;3(8):1555-1562.

18. Hall JE. The Kidney, Hypertension, and Obesity. *Hypertension*. 2003;41(3 Pt 2):625-33.

19. Loh K, Rani F, Chan T, et al. The Association between risk factors and hypertension in Perak, Malaysia. *Med J Malaysia*. 2013;68(4):291-296.

20. Sakurai M, Miura K, Tkamura T, et al. Gender differences in the association between anthropometric indices of obesity and blood pressure in Japanese. *Hypertens Res*. 2006;29(2):75-80.

21. Jain J, Mathur H, Apte S, et al. Prevalence of pre hypertension and hypertension and its correlation with anthropometric measurements in medical students of Central India. *Journal of Evaluation of Medical and Dental Sciences*. 2014;3(10):2429-2433.

22. Celermajer DS, Sorensen KE, Spiegelhalter DJ, et al. Aging is associated with endothelial dysfunction in healthy men years before the age-related decline in women. *J Am Coll Cardiol*. 1994;24:471-476.

23. Despres JP. Body fat distribution and risk of cardiovascular disease: An update. *Circulation*. 2012;126(10):1301-1313.

24. Mullie P, Vansant G, Hulens M, et al. Evaluation of body fat estimated from body mass index and impedance in Belgian male military candidates: Comparing two methods for estimating body composition. *Mil Med*. 2008;173(3):266-270.