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The Association between Body Fat Percentage and Incidence of Prehypertension among Medical Student

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ABSTRACT

INTRODUCTION. The prevalence of prehypertension in Indonesia is 48,4%. Obesity is one of the risk factors for developing prehypertension. Obesity can be measured using body fat percentage. A high body fat percentage will increase the level of plasma angiotensinogen, renin, the activity angiotensin-converting enzyme, and aldosterone. These factors contribute to higher blood pressure. This study aims to determine whether there is a significant association between body fat percentage and incidence of prehypertension.

METHODS. This study is an analytic study with cross-sectional study approach. Data collection was carried out with a total of 106 respondents aged around 17- 22 years. This researched was conducted from August to September 2019 at the Faculty of Medicine and Health Science of Atma Jaya. The research data were collected through filling out a demographic questionnaire, blood pressure measurement using sphygmomanometer, and body fat percentage measurement using bioelectrical impedance analysis. Bivariate analysis of the association between gender and blood pressure, the association between gender and body fat percentage, and the association of body fat percentage with blood pressure were analyzed using the chi-square method.

RESULTS. The bivariate analysis shows that there is a significant association between gender and blood pressure (p=0,001), the association between gender and body fat percentage (p=0,000) and the association between body fat percentage and the incidence of prehypertension (p=0,000) with OR = 3,992

CONCLUSION. A high body fat percentage is a risk factor for developing prehypertension.

KEYWORDS. prehypertension, aldosterone, renin, human AGT protein, blood pressure determination.

INTRODUCTION

Based on the Eighth Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-8), prehypertension is defined as a condition when systolic blood pressure reaches 120 - 139 mmHg, and diastolic blood pressure reaches 80-89 mmHg.[1] Prevalence of prehypertension In the Asian region is quite high. It is known that the prevalence of prehypertension in Indonesia is 48.4%.[2] According to research by Peltzer et al. In 2017, the prevalence of prehypertension among students in Indonesia was 11.5%. [3]

The incidence of prehypertension deserves further attention because it can increase a person's risk for hypertension and other cardiovascular diseases. Prehypertension can increase a person's risk of developing hypertension and cardiovascular disease. Individuals with prehypertension have 2-3 times the risk of developing hypertension than normotensive individuals. [4]

One of the risk factors for prehypertension is obesity. Obesity is defined as a state of excess adipose tissue in the body.[5] Obesity can be measured by calculating the percentage of body fat. Percentage of body fat is the proportion between fat mass and lean body mass multiplied by 100 per cent.[6] A high percentage of body fat is associated with an increased risk of hypertension and prehypertension. [7] According to research conducted by Ye et al. A high percentage of body fat can increase blood pressure, thus triggering the incidence of prehypertension and hypertension.[8] Besides, according to research conducted by Phillips et al., body fat percentage can be a better indicator of obesity and cardiometabolic disease risk than body mass index (BMI).[9]

The purpose of this study was to determine the relationship between the percentage of body fat and the incidence of prehypertension in preclinical students of the Faculty of Medicine and Health Sciences, Universitas Atma Jaya. This research is expected to provide information for other researchers and to develop this research topic so that it can be widely used.

METHOD

This research is an analytical study with a cross-sectional study approach. This research was conducted from August to September 2019 at the Faculty of Medicine and Health Sciences, Universitas Atma Jaya, Indonesia, with a total of 106 respondents aged around 17-22 years. Data were obtained through filling out demographic questionnaires. Blood pressure was measured using a sphygmomanometer—the percentage of body fat with bioelectrical impedance analysis. Bivariate analysis of the relationship between gender, blood pressure and the percentage of body fat were using the chi-square.

RESULTS

Table 1 shows the demographic characteristics of FKIK UAJ preclinical students. One hundred six respondents consisted of 42 (40.4%) female respondents, and 65 (59.6%) male respondents. There were 44 (41.5%) respondents with an average body fat percentage and 62 (58.5%) respondents with a high body fat percentage. There were 53 (50%) respondents with normotensive blood pressure and 53 (50%) respondents with prehypertensive blood pressure.

Table 2 shows the results of the bivariate analysis of the relationship between sex and blood pressure using the chi-square test. There was a significant relationship between male gender and the incidence of prehypertension (p = 0.001).

Table 3 shows the results of the bivariate analysis of the relationship between sex and body fat percentage using the chi-square test. There is a significant relationship between male gender and body fat percentage (p = 0.000).

Table 4 shows the results of the bivariate analysis of the relationship between body fat percentage and the incidence of prehypertension using the chi-square test. There was a significant relationship between the percentage of body fat and the incidence of prehypertension (p = 0.000). Respondents with a high percentage of body fat have a 3.9 times greater risk of developing prehypertension compared to respondents who have a normal body fat percentage (OR: 3.992)

Table 1. Participant characteristic

Characteristic	n	%
Gender		
Male	42	40,4
Female	64	59,6
Total	106	100
Body Fat Percentage		
Normal		
Male (8,0 – 19,9%)	7	16,7
Female (21,0 – 32,9%)	37	83,3
Total	44	100
High		
Male (≥20,0%)	35	56,5
Female(≥33,0)	27	43,5
Total	62	100

Blood Pressure		
Normotension (systole <120 mmHg and diastole <80 mmHg)		
Male	12	23,5
Female	41	76,5
Total	53	100
Prehypertension (systole 120 – 139 mmHg or diastole 80 – 89 mmHg)		
Male	30	56,6
Female	23	43,4
Total	53	100

Table 2. Relationship between gender and blood pressure

	Blood pressure				**p**
	Normotensive		Prehypertension		
	N	**%**	**n**	**%**	
Gender					
Male	12	23,5	30	56,6	0,001*
Female	41	76,5	23	43,4	
Total	53	100	53	100	

Table 3. Relationship between gender and body fat percentage

	Body fat percentage				P
	Normal		High		
	n	%	N	%	
Gender					
Male	7	16,7	35	56,5	0,000*
Female	37	83,3	27	43,5	
Total	44	100	62	100	

Table 4. Relationship between blood pressure and body fat percentage

	Blood pressure					
	Normotensive		Prehipertension		p	OR
	n	%	n	%		
Body fat						
Normal	40	76,5	4	5,7	0,000*	3,992
High	12	23,5	50	94,3		
Total	52	100	54	100		

DISCUSSION

In this study, it was found that men tended to experience prehypertension compared to women. These results are consistent with research conducted by Syme et al., which found that most adult men tend to have a higher blood pressure than women, especially those classified as obese.[10] Besides, the results of this study also show that most women tend to have higher blood pressure. This result is in line with a study conducted by Joyner et al., which also states that young adult women tend to have a lower blood pressure than men. [11]

The tendency of prehypertension in men is due to the activity of the sympathetic nervous system, and the total peripheral resistance in men is higher than in women so that the blood pressure of men will also tend to be higher.[11,12] Meanwhile, in women, according to research conducted by Reckelhoff, has a protective factor in the form of the hormone estrogen, which keeps blood pressure

from increasing. It is because the hormone estrogen will increase the activation of the β-adrenergic receptors which function as a vasodilator.

The results of this study indicate that men tend to have a higher percentage of fat than women. It is in line with research conducted by Sasongko, which states that most male students have a relatively high percentage of body fat.[14] This study also found that women had a body fat percentage that was classified as usual. The same result was also obtained in a study conducted by Utami, that most women had a body fat percentage in the normal range.

Research conducted by Karastegiou et al. stated that the high percentage of body fat in men is due to the low activity of the lipoprotein lipase enzyme and more uptake of free fatty acids from food in men.16 Insulin work for lipolysis is also considered less effective in men if compared to women. The results in men having a higher body fat percentage. [16,17]

The results of this study are different from research by Hung et al., which states that the proportion of women with a high body fat percentage is more significant than that of men.[18] According to a study conducted by Palmer et al., this is caused by the female hormone estrogen. The hormone estrogen will facilitate fat deposits in adipose tissue through the activation mechanism of estrogen receptors on adipocytes in adipose tissue so that in women tends to accumulate subcutaneous fat.

The difference between the results of this study and the research conducted by Hung et al. can be due to differences in the characteristics of the respondents which can affect the percentage of body fat such as age, ethnicity, lifestyle, genetic susceptibility, and hydration factors. [20] It can also be due to the many differences and the lack of research in determining the optimal cut off for body fat percentage.

The results of this study indicate that there is a significant relationship between body fat percentage and the incidence of prehypertension. The results also show that a high percentage of body fat can increase the risk of prehypertension by up to four times compared to the percentage of healthy body fat. The results of this study are the following research conducted by Kilinc et al. in Turkey, which states that a high percentage of body fat will increase systolic and diastolic blood pressure.

Research conducted by Goutham et al. stated that individuals with a high percentage of body fat have a six times higher risk of developing prehypertension and hypertension than individuals with an average body fat percentage.[23]

This can be due to the accumulation of adipose tissue in individuals with a high percentage of body fat. Adipocyte cells in these tissues will secrete pro-inflammatory, pro-coagulant and

angiotensinogen cytokines. [24] According to studies conducted by Schutten et al. and Ramalingam et al., the increase in blood pressure that occurs in individuals with a high percentage of body fat is due to increased plasma levels of angiotensinogen, renin, and the activity of rennin angiotensin-converting enzyme. [25,26] Also, The high percentage of body fat will cause stiffness in the endothelium and smooth muscle of blood vessels, inflammation in the perivascular area, and immune system dysfunction leading to an increase in blood pressure.[27]

The results of this study also indicate that the percentage of body fat can be a good predictor for predicting the occurrence of cardiometabolic disease.[7] This is in line with research conducted by Phillips et al., which states that body fat percentage can be a better indicator for assessing obesity and the risk of other cardiometabolic diseases than body mass index (BMI).[9] Besides, body fat percentage can also be a marker which is useful for identifying the risk of prehypertension in young adults.[28]

CONCLUSION

There is a significant relationship between the percentage of body fat and the incidence of prehypertension. Besides, men are more likely to experience prehypertension than women. The percentage of body fat in men also tends to be higher than that of women.

REFERENCES

1. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, et al. 2014 Evidence-Based Guideline for the Management of High Blood Pressure in Adults: Report From the Panel Members Appointed to the Eighth Joint National Committee (JNC 8). JAMA. 2014 Feb 5;311(5):507–20.
2. Kesehatan D, RI KK. Riset Kesehatan Dasar. Jakarta : Badan Penelitian dan Pengembangan Kesehatan Departemen Kesehatan Republik Indonesia. 2007;
3. Peltzer K, Pengpid S, Sychareun V, Ferrer AJG, Low WY, Huu TN, et al. Prehypertension and psychosocial risk factors among university students in ASEAN countries. BMC Cardiovasc Disord [Internet]. 2017 Aug 23 [cited 2018 Oct 18];17. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5569482/
4. Egan BM, Stevens-Fabry S. Prehypertension—prevalence, health risks, and management strategies. Nature Reviews Cardiology. 2015 May;12(5):289–300.

5. What is Obesity? - Obesity Action Coalition [Internet]. [cited 2019 Oct 30]. Available from: https://www.obesityaction.org/get-educated/understanding-your-weight-and-health/what-is-obesity/
6. Zeng Q, Dong S-Y, Sun X-N, Xie J, Cui YPer centnt body fat is a better predictor of cardiovascular risk factors than body mass index. Brazilian Journal of Medical and Biological Research. 2012 Jul;45(7):591–600.
7. Wang Z, Zeng X, Chen Z, Wang X, Zhang L, Zhu M, et al. Association of visceral and total body fat with hypertension and prehypertension in a middle-aged Chinese population. Journal of Hypertension. 2015 Aug;33(8):1555.
8. Ye S, Zhu C, Wei C, Yang M, Zheng W, Gan D, et al. Associations of Body Composition with Blood Pressure and Hypertension. Obesity. 2018 Oct 1;26(10):1644–50.
9. Phillips CM, Tierney AC, Perez-Martinez P, Defoort C, Blaak EE, Gjelstad IMF, et al. Obesity and body fat classification in the metabolic syndrome: impact on cardiometabolic risk mmetal type Obesity (Silver Spring). 2013 Jan;21(1):E154-161.
10. Syme Catriona, Shin Jean, Richer Louis, Gaudet Daniel, Paus Tomáš, Pausova Zdenka. Sex Differences in Blood Pressure Hemodynamics in Middle-Aged Adults With Overweight and Obesity. Hypertension. 2019 Aug 1;74(2):407–12.
11. Sex differences and blood pressure regulation in humans - Joyner - 2016 - Experimental Physiology - Wiley Online Library [Internet]. [cited 2019 Oct 4]. Available from: https://physoc.onlinelibrary.wiley.com/doi/full/10.1113/EP085146
12. Huang C-C, Chung C-M, Leu H-B, Lin L-Y, Huang P-H, Lin S-J, et al. P5371Gender differences in sympathetic nervous system activity and 24-hour ambulatory blood pressure in young-onset hypertension patients. Eur Heart J [Internet]. 2018 Aug 1 [cited 2019 Oct 7];39(suppl_1). Available from: https://academic.oup.com/eurheartj/article/39/suppl_1/ehy566.P5371/5083564
13. Reckelhoff JF. Androgens and Blood Pressure Control: Sex Differences and Mechanisms. Mayo Clinic Proceedings. 2019 Mar 1;94(3):536–43.
14. Rahmadani Sasongko 14711044. Hubungan Kadar Lemak Tubuh dengan Lipatan Kulit Trisep dan Subskapular pada Mahasiswa Laki-laki Fakultas Kedokteran Universitas Islam Indonesia Angkatan 2014. 2018 May 28 [cited 2019 Oct 7]; Available from: https://dspace.uii.ac.id/handle/123456789/8385

15. Utami WP, Indraswari DA. Perbandingan Pengaruh Lari Rutin Dengan Lari Rutin Ditambah Latihan Otot Inti Terhadap Persentase Lemak Dan Massa Tulang Pada Mahasiswi Fakultas Kedokteran Undip. Jurnal Kedokteran Diponegoro. 2016;5(4):1886–93.
16. Karastergiou K, Smith SR, Greenberg AS, Fried SK. Sex differences in human adipose tissues – the biology of pear shape. Biol Sex Differ. 2012 May 31;3:13.
17. Frank AP, Santos R de S, Palmer BF, Clegg DJ. Determinants of body fat distribution in humans may provide insight about obesity-related health risks. J Lipid Res. 2019 Oct 1;60(10):1710–9.
18. Hung S-P, Chen C-Y, Guo F-R, Chang C-I, Jan C-F. Combine body mass index and body fat percentage measures to improve the accuracy of obesity screening in young adults. Obesity Research & Clinical Practice. 2017 Jan 1;11(1):11–8.
19. Palmer BF, Clegg DJ. The sexual dimorphism of obesity. Molecular and Cellular Endocrinology. 2015 Feb 15;402:113–9.
20. Sergi G, De Rui M, Stubbs B, Veronese N, Manzato E. Measurement of lean body mass using bioelectrical impedance analysis: a consideration of the pros and cons. Aging Clin Exp Res. 2017 Aug 1;29(4):591–7.
21. Oreopoulos A, Lavie CJ, Snitker S, Romero-Corral A. More on Body Fat Cutoff Points–Reply–I. Mayo Clin Proc. 2011 Jun;86(6):584–5.
22. Çöl N, Kilinc A, Demircioğlu-Kılıç B, Aydin N, Keskin M, Balat A. Predictive value of the "Blood Pressure To Height Ratio" in diagnosis of prehypertension and hypertension during childhood in Southeastern Turkey. Clinical and Experimental Hypertension. 2019 Jan 2;41(1):14–9.
23. Hs R, As G, D P. Body mass index, waist hip ratio and body fat percentage as early predictors of pre-diabetes and prehypertension in adolescents. Current Pediatric Research [Internet]. 2017 [cited 2019 Oct 10]; Available from: abstract/body-mass-index-waist-hip-ratio-and-body-fat-percentage-as-earlyrnpredictors-of-prediabetes-and-prehypertension-in-adolescents-7200.html
24. Churniawati L, Martini S, Wahyuni CU. Prehipertensi pada Obesitas Abdominal. Kesmas: National Public Health Journal. 2015 May 1;9(4):293.
25. Schütten MTJ, Houben AJHM, de Leeuw PW, Stehouwer CDA. The Link Between Adipose Tissue Renin-Angiotensin-Aldosterone System Signaling and Obesity-Associated Hypertension. Physiology. 2017 Apr 12;32(3):197–209.

26. Ramalingam L, LeMieux M, Scoggin shane, Adrovet Z, Kalupahana N, Moustaïd-Moussa N. Adipose Angiotensinogen Overexpression Promotes Adipose Associated Inflammation and Endoplasmic Reticulum Stress. The FASEB Journal. 2015 Apr 1;29(1_supplement):LB289.
27. Fazliana M, Liyana AZ, Omar A, Ambak R, Mohamad Nor NS, Shamsudin UK, et al. Effects of weight loss intervention on body composition and blood pressure among overweight and obese women: findings from the MyBFF@home study. BMC Women's Health. 2018 Jul 19;18(1):93.
28. Wang S, Peng R, Liang S, Dong K, Nie W, Yang Q, et al. Comparison of adiposity index in relation to prehypertension by age and gender: a community-based survey in Henan, China. Clinical Cardiology [Internet]. 2018 Oct 3 [cited 2018 Oct 30];0(ja). Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/clc.23086