Association of general and central obesity with hypertension

doi: 10.1016/j.clnu.2017.05.012

Association of General and Central Obesity with Hypertension

Yuri Nurdiantami [a], Kumi Watanabe [a], Emiko Tanaka [a], Julianty Pradono [b], Tokie Anme [a,*]

[a] *Graduate School of Comprehensive Human Sciences, University of Tsukuba, Tsukuba, Japan*

[b] *National Institute of Health and Research Development, Ministry of Health Republic of Indonesia, Jakarta, Indonesia*

Abstract

Background and aim: Hypertension as a risk factor for cardiovascular disease has growing prevalence. An increase in body weight is typically followed by an increase in blood pressure. This study aimed to investigate the association of general and central obesity with hypertension in Indonesian women using WHO and Indonesian classification systems.

Methods: Cross-sectional study of Indonesian women aged 18 years or and more (313,714 participants), using national level Indonesia National Basic Health Research (2013).

Results: The prevalence of hypertension in Indonesian women in this study was 32.8%. Based on logistic regression analysis, hypertension was significantly associated with residential area, educational attainment, self-reported smoking status, cardiovascular disease, chronic kidney disease, diabetes mellitus, body mass index and waist circumference. Furthermore, the odds of having hypertension for general and central obesity according to WHO classification were adjusted odds ration (aOR) 2.61, 95% CI 2.52-2.70 and aOR 1.50, 95% CI 1.46-1.53. By Indonesian classification were aOR 2.21, 95% CI 2.16-2.26 and aOR 1.48, 95% CI 1.45-1.51.

Conclusion: By using International WHO and standard Indonesia classification systems, general and central obesity were associated with hypertension in Indonesia women. Thus, not only general obesity but also central obesity should be used to assess obesity in Indonesian women.

Keywords: hypertension, general obesity, central obesity, Indonesian women.

*Corresponding author. Department of International Community Care and Life-span Development: Empowerment Sciences, University of Tsukuba. Tel.: +81 (0)3-5474-2789. Email addresses: nurdiantamiyuri@gmail.com (Y. Nurdiantami), anmet@md.tsukuba.ac.jp (T.Anme)

1. Introduction

Hypertension, known as a silent killer , contributes to cardiovascular disease, stroke and premature mortality (1). In Indonesia, cardiovascular disease is the number one cause of death (2). Both general and central obesity can be used to identify hypertension. (3,4). Furthermore, increase in arterial pressure was shown to be associated with weight gain and it is estimated that 60-70% of adults hypertension is related to adiposity (5). Thus, not only body mass index (BMI) but also waist circumference (WC) should be considered when assessing hypertension risk (6).

In Indonesia, obesity has shown an increasing trend from year to year, with women having a higher prevalence of obesity (7). Moreover, women have greater population attributable risk levels related to excess weight for hypertension compared to men (8).

The use of lower BMI cut-offs for the Indo-Asian population may be required to give optimal identification of people who are at risk of getting hypertension (9). People in Asia and Europe have different associations between body fat level, BMI score, and health risks (10). Thus it is important to consider the differences in BMI classification system to ensure a valid and reliable system to assess obesity (11). To the best of author's knowledge, there are no other studies using recent and national scale data to examine the association of both general and central obesity with hypertension in Indonesian people.

2. Methods

2.1. Study population

The subjects were Indonesian women aged 18 or above. The subjects were selected from Indonesia Basic Health Research (RISKESDAS) 2013, a national scale research that collected basic health data and indicators. Ethics for the survey was accepted by the committee of the National Institute of Health and Research Development, Ministry of Health, Republic of Indonesia. Pregnant subjects, and those with missing data on BMI, WC, and blood pressure, were excluded from the study. Hypertension was defined if one of the following status applied: systolic blood pressure (SBP) $\geq$ 140 mmHg; diastolic blood pressure (DBP) $\geq$ 90 mmHg; or presently taking medicine for hypertension. This study used the mean of two times blood pressure measurements.

2.2. General and central obesity categories

The study used both World Health Organization and Indonesian classification for general and central obesity. General obesity was determined by BMI in kg/m^2. WHO classification for BMI are underweight = BMI < 18.5 kg/m^2; normal = BMI 18.5-24.99 kg/m^2; overweight = BMI 25-29.99 kg/m^2 and obese = BMI $\geq$ 30 kg/m^2 (10). The Indonesian classification for BMI are underweight = BMI < 18.5 kg/m^2; normal = BMI 18.5-24.99 kg/m^2; overweight = BMI 25-26.99 kg/m^2; and obese = BMI $\geq$ 27 kg/m^2 (7).

Central obesity was assessed by measuring waist circumference. In the study, the participants waist circumference size was measured at a central point between the lower ribs and iliac crest (12). The cut-offs for central obesity in WHO and Indonesian classifications are $\geq$ 88 cm and $\geq$ 80 cm, respectively (7,13).

2.3. Covariates

Responses to the questions from the RISKESDAS questionnaire were used to obtain the covariates. Data for age was obtained from the household member question section. Age was grouped into young age = 18-39 years old, middle age = 40-54 years old, and old age = $\geq$ 55 years old. Residential area was classified as rural or urban areas. Marital status was classified as single or married. Educational attainment was categorized into three groups with high school as cut-off points (less than high school, high school, more than high school). The question about chronic kidney disease was phrased as “Have you ever been diagnosed you with chronic kidney disease (minimum of three consecutive months) by a doctor?” with yes and no responses. The question about diabetes mellitus was phrased as “Have you ever been diagnosed with diabetes mellitus by a doctor?” with yes and no responses. The question about hyperthyroid was phrased as “Have you ever been diagnosed with hyperthyroid by a doctor?” with yes and no responses. Cardiovascular disease data was obtained by a response to the question “Have you ever been diagnosed with heart failure or coronary heart disease by a doctor?” with yes and no responses. Self-reported smoking status was ascertained by the response from the tobacco consumption question and participants were grouped based on smoking history as: never, former or current smokers. Physical activity was obtained from the question: “Do you usually have continuous moderate physical activity for at least for 10 minutes for each activity?” and participants were classified based on WHO Global Physical

Activity Questionnaire analysis guide as less active if total physical activity time is 0 to < 150 minutes and active, for 150 or more minutes/week (13).

2.4. Statistical analysis

Continuous variables were described as mean (M) ± standard deviation (SD) while categorical variables as frequencies and percentages. The difference between hypertensive and normotensive groups in this study was compared by chi-squared test for categorical variables and paired t-test for continuous variables. Spearman correlation analysis was conducted to check the correlation of each research variable.

Logistic regression analysis was done to measure the crude and adjusted odds ratio along with 95% confidence interval. Variables showing significant association with hypertension by alpha level <0.05 were selected as covariates in the adjusted logistic regression analysis. Hypertension was examined as outcome variable along with BMI and central obesity as predictor variables adjusted for age, residential area, educational attainment, chronic kidney disease, self-reported smoking status, cardiovascular disease, diabetes mellitus and hyperthyroid. All of the analyses were conducted in SPSS 22.0 (SPSS Inc., Chicago, IL).

3. Results

A total of 346,799 subjects aged ≥ 18 years old were examined. From those examined, 33,085 participants were excluded with detail of 7464 women in pregnancy; 13,777 due to missing data on blood pressure measurement; 11,844 because of missing data on BMI and WC. The final analytical sample included 313,714 participants.

Table 1 presents the prevalence of hypertension in Indonesian women based on their characteristics. The overall rate of hypertension was 32.8 % and it is significantly associated with residential area, educational attainment, cardiovascular disease, chronic kidney disease, self-reported smoking status, diabetes mellitus, hyperthyroid, BMI, and WC. Those people living in urban areas, married, and former smokers, tend to have higher hypertension prevalence. People with diabetes mellitus, hyperthyroid, cardiovascular or chronic kidney disease have higher hypertension prevalence compared to those without the disease. The comparison between hypertensive and normotensive groups was listed in Table 2. There were significant differences for all characteristics inspected between normotensive and

hypertensive groups. The hypertensive group was significantly older in age; higher in weight, BMI, WC, SBP, and DBP, compared to normotensive group.

In logistic regression model utilizing Indonesia classification, all covariates except for living in rural area and former smokers were significantly associated with hypertension. The odds for general obese people to get hypertension were about 2.21 times higher compared to people with normal BMI and the odds for central obese people were 1.48 times higher as compared to people without central obesity after adjusting for the covariates.

In WHO classification, all covariates except for former smokers were significantly associated with hypertension. The odds for general obese people to get hypertension were about 2.61 times higher compared to people with normal BMI and the odds for central obese people were 1.50 times higher compared to people without central obesity after adjusting for the covariates.

Table and Figure legends

Table 1. Prevalence of hypertension by characteristics[1]

	Total	Normotensive	%	Hypertensive	%	*P*
N	313,714	210,889	67.2	102,825	32.8	
Age group						
Young	148,103	123,363	83,3	24,740	16,7	
Middle	101,841	61,237	60,1	40,604	34,3	<0.001
Old	63,770	26,289	41,2	37,481	58,8	
Place of living						
Urban	146,796	97,821	66.6	48,975	33.4	<0.001
Rural	166,918	113,068	67.7	53,850	32.3	
Marital status						
Single	80,260	54,109	67.4	26,151	32.6	0.175
Married	233,454	156,780	67.2	76,674	32.8	
Educational attainment						
Less than high school	218,996	137,361	62.7	81,635	37.3	
High school	71,595	55,788	77.9	15,807	22.1	<0.001
More than high school	23,123	17,740	76.7	5,383	23.3	
Physical activity						
Active	147,583	99,124	67.2	48,459	32.8	0.512
Less active	166,131	111,765	67.3	54,366	32.7	
Cardiovascular disease						
Yes	2,445	891	36.4	1,554	63.6	<0.001
No	311,269	209,998	67.5	101,271	32.5	
Chronic kidney disease						
Yes	683	326	47.7	357	52.3	<0.001
No	313,031	210,563	67.3	102,468	32.7	
Self-reported smoking status						
Never	302,920	204,251	67.4	98,669	32.6	
Former	2,648	1,501	56.7	1,147	43.3	<0.001
Current	8,146	5,137	63.1	3,009	36.9	
Diabetes mellitus						
Yes	6,617	2,578	39.0	4,039	61.0	<0.001
No	307,097	208,311	67.8	98,786	32.2	
Hyperthyroid						
Yes	1,956	1,151	58.8	805	41.2	<0.001
No	311,758	209,738	67.3	102,020	32.7	
Indonesia Classification BMI						
Normal	176,971	129,285	73.1	47,686	26.9	
Overweight	40,653	25,197	62.0	15,456	38.0	< 0.001
Obese	63,258	32,373	51.2	30,885	48.8	
Central obesity						
No	168,409	126,339	75.0	42,070	25.0	< 0.001
Yes	145,305	84,550	58.2	60,755	41.8	
WHO classification BMI						
Normal	176,971	129,285	73.1	47,686	26.9	< 0.001
Overweight	77,373	45,396	58.7	31,977	41.3	

[1] Calculated using SPSS version 22

Obese	26,538	12,174	45.9	14,364	54.1	
Central obesity						
No	249,492	179,034	71.8	70,458	28.2	< 0.001
Yes	64,222	31,855	49.6	32,367	50.4	

Table 2. Characteristics comparison between hypertensive and normotensive groups[2]

	Hypertensive		Normotensive		P-value
	M	*SD*	*M*	*SD*	
Age (year)	50.07	14.33	38.04	13.57	< 0.001
Weight (kg)	56.24	12.33	53.27	10.18	< 0.001
Height (cm)	150.42	6.50	152.14	6.17	< 0.001
BMI (kg/m^2)	24.80	4.98	23.00	4.16	< 0.001
WC (cm)	82.29	12.44	77.27	10.67	< 0.001
SBP (mmHg)	150.73	23.06	115.55	11.22	< 0.001
DBP (mmHg)	95.68	11.42	76.95	7.32	< 0.001

[2] Calculated using SPSS ver 2.3

Table 3. Logistic regression analysis

	Hypertension			
	Indonesian Classification		WHO Classification	
	OR (95% CI)	aOR[3] (95% CI)	OR (95% CI)	aOR (95% CI)
Age group (years)				
Young	-	-	-	-
Middle	1.60 (1.57-1.62)	2.75 (2.70-2.80)	1.60 (1.57-1.62)	2.78 (2.72-2.83)
Old	4.03 (3.96-4.10)	6.79 (6.64-6.95)	4.03 (3.96-4.10)	6.74 (6.59-6.89)
Residential area				
Urban	-	-	-	-
Rural	0.95 (0.94-0.97)	0.98 (0.96-0.99)	0.95 (0.94-0.97)	0.97 (0.95–0.99)
Educational attainment				
Less than high school	2.06 (2.03-2.10)	1.44 (1.41-1.47)	2.06 (2.03-2.10)	1.44 (1.41-1.47)
High school	-	-	-	-
More than high school	0.60 (0.58-0.62)	0.91 (0.88-0.95)	0.60 (0.58-0.62	0.92 (0.88-0.95)
Diabetes mellitus				
No	-	-	-	-
Yes	3.30 (3.14-3.47)	1.66 (1.57-1.75)	3.30 (3.14-3.47)	1.68 (1.59-1.78)
Self-reported smoking status				
Never	-	-	-	-
Former	1.57 (1.46-1.70)	1.14 (1.05-1.24)	1.57 (1.46-1.70)	1.14 (1.05-1.24)
Current	1.21 (1.15-1.26)	0.92 (0.87-0.96)	1.21 (1.15-1.26)	0.91 (0.87-0.96)
Chronic kidney disease				
No	-	-	-	-
Yes	2.25 (1.94-2.62)	1.41 (1.19-1.66)	2.25 (1.94-2.62)	1.39 (1.17-1.64)
Cardiovascular disease				
No	-	-	-	-
Yes	3.62 (3.33-3.93)	2.06 (1.88-2.25)	3.62 (3.33-3.93)	2.07 (1.89-2.27)
Hyperthyroid				
No	-	-	-	-
Yes	1.44 (1.31-1.57)	1.20 (1.09-1.33)	1.44 (1.31-1.57)	1.21 (1.09-1.33)
BMI				
Normal	-	-	-	-
Overweight	1.30 (1.27-1.33)	1.44 (1.41-1.48)	1.65 (1.62-1.67)	1.72 (1.68-1.75)
Obese	2.37 (2.33-2.41)	2.21 (2.16-2.26)	2.65 (2.58-2.72)	2.61 (2.52-2.70)
Central obesity				
No	-	-	-	-
Yes	2.16 (2.13-2.19)	1.48 (1.45-1.51)	2.58 (2.54-2.63)	1.50 (1.46-1.53)

[3] Adjusted odds ratio

4. Discussion

Hypertension in Indonesia is a growing problem with dramatic increases of raised blood pressure in adults from 5% in 1998 to 32% in 2008 (14). In this study, the rate of hypertension in Indonesian women using established Indonesia classification was 32.8%. Compared to men, the prevalence of both obesity and hypertension in Indonesia is higher in women (15). The higher rate of women with hypertension in Indonesia is interesting as other south east Asian countries have higher prevalence in men (14). In general, the risk factors contributing to the high prevalence of hypertension in Indonesia may be due to an aging population, genetic factors, less physical activity, and an inappropriate diet that may lead to the increasing prevalence of obesity (15,16).

Hypertension is significantly associated with residential area, educational attainment, cardiovascular disease, chronic kidney disease, smoking, diabetes mellitus, hyperthyroid, BMI, and WC. People living in urban areas, married people, and former smokers, tend to have higher hypertension prevalence. People with diabetes mellitus, hyperthyroid, cardiovascular or chronic kidney disease have higher hypertension prevalence compared to those without the above diseases.

Hypertension prevalence is increasing respective to weight gain. In this study, 48.8% of obese people have hypertension by using Indonesian cut-off value, and 54.1% of obese people have hypertension by using WHO cut-off value. The results are similar to previous findings in which higher BMI resulted in higher prevalence of hypertension (16–18). Several mechanisms support the effect of weight gain on increasing blood pressure. Both total body fat described as BMI and abdominal fat described as WC affect blood pressure by several mechanisms including insulin resistance, which results in greater fatty acid release attributable to hypertension and the other mechanism, adipokines release such as leptin by increasing sympathetic outflow (5,19).

These physiological mechanisms support the major finding in this study that, after adjusting for all covariates, general and central obesity were associated with hypertension in Indonesian women according to established Indonesian or WHO classifications for obesity. Indonesian women with general obesity have a twofold excess risk to developing hypertension compared to non-obese members of the population. The previous finding found that the increasing trend of being overweight or obese among women caused by higher

socioeconomic status and residence in urban areas has a strong connection with the risk to have high blood pressure (20).

In detail, based on Indonesia classification, the odds for generally obese people to develop hypertension were 2.21 times higher compared to people with normal BMI and the odds for abdominally obese people were 1.48 times higher, as compared to people without abdominal obesity after adjusting for the covariates. Using WHO classification, the odds for generally obese people to get hypertension were about 2.61 times higher compared to people with normal BMI and the odds for abdominally obese people were 1.50 times higher compared to people without abdominal obesity after adjusting for the covariates.

The result in this study showed that having abdominal obesity will also give a risk to get hypertension. The association and odds of hypertension is consistent with several previous studies (21–23), one previous study stated in detail that for every additional 1 cm in waist circumference, the odds for hypertension is 1.04 times higher (24). Therefore, both BMI and waist circumference should be examined to assess hypertension in Indonesian women. This is consistent with the a previous study that suggests using not only BMI but also WC as significant predictors of hypertension in the population (25).

Both general and central obesity assessment are important to improve the evaluation of potential health risks and to provide accurate prognosis by estimating fat distributions. Additionally, previous research found that each fat depots such as lower body, upper body and visceral have unique characteristics related to the metabolism of fatty acid (26). For people at risk who tend to store their excess weight abdominally, determination of waist circumference will help to improve the treatment (27). Therefore, in assessing patients with health risks associated with obesity, measuring waist circumference as a complement of simple BMI measurement is necessary.

The odds of having hypertension and the rate of general as well as central obesity using the Indonesia classification differed from WHO classification. In general, Asian people are likely to have a higher percentage of total body fat and central adiposity compared to Caucasian people (10,27). Considering this difference, the International diabetes federation suggested a threshold for waist circumference is more than or equivalent to 80 cm for Asian women (28). Another research conducted on a population in Pakistan found out that a quarter of the study population was classified as overweight or obese using the Asian cut-offs

(9). The use of a lower BMI classification may provide reliable estimation and optimal identification of obesity-related disease risks in Asian populations (29).

The large sample size equipped with various confounders and nationally representative data increased the validity of this study. Nevertheless, one limitation of this study is it is cross-sectional study that gives only a one-time measurement for classifying the BMI and WC score from the participants. Therefore, it is difficult to state a direct causal inference. Further longitudinal studies are needed to asses the effect size of general and central obesity on hypertension.

Acknowledgement

The study was supported by the Indonesia National Institute of Health and Research Development, Ministry of Health, Republic of Indonesia.

Conflict of interest

There is no conflict of interest.

References

1. World Health Organization. World Health Day 2013. A Global Brief on Hypertension. 2013;9.
2. Indonesia Ministry of Health. Infodatin : Situasi Kesehatan Jantung. Central Data Information, Indonesia Ministry of Health. 2014;1–8.
3. Wang S-K, Ma W, Wang S, Yi X-R, Jia H-Y, Xue F. Obesity and Its Relationship with Hypertension among Adults 50 Years and Older in Jinan, China. PLoS One. 2014;9(12).
4. Gus M. Association between different measurements of obesity and the incidence of hypertension. Am J Hypertens. 2004;17(1):50–3.
5. Kotchen TA. Obesity-Related Hypertension: Epidemiology, Pathophysiology, and Clinical Management. Am J Hypertens. Nature Publishing Group; 2010;23(11):1170–8.
6. Ostchega Y, Hughes JP, Terry A, Fakhouri THI, Miller I. Abdominal Obesity, Body Mass Index, and Hypertension in US Adults: NHANES 2007–2010. Am J Hypertens. 2012;25(12):1271–8.
7. Indonesia Ministry of Health. Indonesia Basic Health Research 2013. 2013;111–6.
8. Wilson PWF, D'Agostino RB, Sullivan L, Parise H, Kannel WB. Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. Arch Intern Med. 2002;162(16):1867–72.
9. Jafar TH, Chaturvedi N, Pappas G. Prevalence of overweight and obesity and their association with hypertension and diabetes mellitus in an Indo-Asian population. CMAJ [Internet]. 2006;175(9):1071–7.

10. World Health Organization Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;363(9403):157–63.
11. Gonzalez-Casanova I, Sarmiento OL, Gazmararian JA, Cunningham SA, Martorell R, Pratt M, et al. Comparing three body mass index classification systems to assess overweight and obesity in children and adolescents. Rev Panam Salud Publica. 2013;33(5):349–55.
12. Indonesia Ministry of Health. Assessment and Measurement Guideline for Indonesia Basic Health Research. 2007;22–3.
13. World Health Organization. Global Physical Activity Questionnaire. 2012;2–25.
14. World Health Organization Regional Office of South East Asia. High Blood Pressure-Global and Regional Overview. World Heal Day 2013. 2013;1–2.
15. Indonesia Ministry of Health. Pusdatin Hipertensi. Infodatin. 2014;1–7.
16. Rizkiriani A, Khomsan A, Riyadi H. Obesity and hypertension among adolescents in Jakarta, Indonesia. Pakistan J Nutr. 2014;13(1):17–21.
17. Hwang LC, Bai CH, Sun CA, Chen CJ. Prevalence of metabolically healthy obesity and its impacts on incidences of hypertension, diabetes and the metabolic syndrome in Taiwan. Asia Pac J Clin Nutr. 2012;21(2):227–33.
18. Zhang L, Zhang WH, Zhang L, Wang PY. Prevalence of overweight/obesity and its associations with hypertension, diabetes, dyslipidemia, and metabolic syndrome: A survey in the suburban area of Beijing, 2007. Obes Facts. 2011;4(4):284–9.
19. Katagiri H, Yamada T, Oka Y. Adiposity and cardiovascular disorders: Disturbance of the regulatory system consisting of humoral and neuronal signals. Circ Res. 2007;101(1):27–39.
20. Adair LS. Dramatic rise in overweight and obesity in adult filipino women and risk of hypertension. Obes Res. 2004;12(8):1335–41.
21. Zhang X, Yao S, Sun G, Yu S, Sun Z, Zheng L, et al. Total and abdominal obesity among rural Chinese women and the association with hypertension. Nutrition [Internet]. Elsevier Inc.; 2012;28(1):46–52.
22. Folsom a R, Kushi LH, Anderson KE, Mink PJ, Olson JE, Hong CP, et al. Associations of general and abdominal obesity with multiple health outcomes in older women: the Iowa Women's Health Study. Arch Intern Med. 2000;160(14):2117–28.
23. Singh RB, Fedacko J, Pella D, Macejova Z, Ghosh S, De AK, et al. Prevalence and risk factors for prehypertension and hypertension in five Indian cities. Acta Cardiol. 2011;66(1):29–37.
24. Olinto MT a, Nacul LC, Gigante DP, Costa JSD, Menezes a MB, Macedo S. Waist circumference as a determinant of hypertension and diabetes in Brazilian women: a population-based study. Public Health Nutr. 2004;7(5):629–35.
25. Chei C-L, Iso H, Yamagishi K, Tanigawa T, Cui R, Imano H, et al. Body fat distribution and the risk of hypertension and diabetes among Japanese men and women. Hypertens Res. 2008;31(5):851–7.
26. Jensen M, D. Role of body fat distribution and the metabolic complications of obesity.J Clin Endocrinol Metab 2008;93(11 supl 1): S57-S63
27. Despres J-P, lemieux I, Prud'homme D. Treatment of obesity: need to focus on high risk abdominally obese patients. *BMJ* 2001; 322:716-720
27. Raj PP, Palainvelu C. Guidelines for bariatric (metabolic) surgery for Indian Population.

p.750
28. International Diabetes Federation. The IDF consensus worldwide definition of the metabolic syndrome. IDF Consens Worldw Defin Metab Syndr [Internet]. 2006;28:1–7.
29. Anuurad E, Shiwaku K, Nogi A, Kitajima K, Enkhmaa B, Shimono K, et al. The New BMI Criteria for Asians by the Regional Office for the Western Pacific Region of WHO are Suitable for Screening of Overweight to Prevent Metabolic Syndrome in Elder Japanese Workers. J Occup Health. 2003;45(6):335–43.