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# Risk Factors of Hypertension among Adult in Rural Indonesia

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## ABSTRACT

The aim of this study was to analyse the risk factors of hypertension among adult in rural Indonesia. This cross-sectional study included 112 married couples (112 men and 112 women) aged 45-59 years old and was conducted in Cianjur District, West Java, Indonesia. The measurement of body weight and fat composition used Bioelectrical Impedence Analysis (BIA) monitor (OMRON® Karada Scan Body Composition Monitor HBF-358-BW). Body height was measured by stadiometer, meanwhile waist circumference was measured by measuring tape. Data on the blood pressure measured by an automatic blood pressure monitor (OMRON® Automatic Blood Pressure Monitor Model HEM-7200). All measurement were done twice in repetition. Chi-square was used to analysed the association between variables and logistic regression was used to analyse the risk factors. The prevalence of hypertension was 49.1% (women 54.5%; men 43.7%). Women had a higher proportion of overweight, obesity, abdominal obesity, and hypertension stage 2 than men. BMI ($p<0.05$), waist circumference ($p<0.05$), total body fat ($p<0.05$), and visceral fat ($p<0.05$) were significantly higher in hypertension subject than not hypertension. Nonetheless, only waist circumference became the risk factor for hypertension (OR=4.005; 95%CI:1.47-10.914 for high risk). There is high prevalence of hypertension among adult in rural area. Adult, particularly women need to pay attention on their body fat to reduce the risk of hypertension.

**Keywords**: adults, blood pressure, body composition, body fat, hypertension

## INTRODUCTION

Hypertension is a silent killer that becomes the most prevalent disease in the world. Globally men (24.1%) have higher prevalence of hypertension than women (20.1%) (WHO 2016). High systolic blood pressure is one of the leading risk factors for global disability adjusted life years (DALYs) (Forouzanfar *et al.* 2015). A meta-analysis stated that for every 10 mmHg reduction in systolic blood pressure significantly reduced the risk of cardiovascular disease, coronary heart disease, stroke, and heart failure (Ettehad *et al.* 2015). One of the risk factors for high blood pressure is body weight. Higher body mass index (BMI) is an increased risk for development of hypertension over time (Landsberg *et al.* 2013). Singh *et al.* (2017) revealed that overweight, obesity, abdominal obesity, tobacco, and alcohol consumption are also risk factors for hypertension.

BMI and waist circumference are anthropometric measurements that commonly used to determine nutritional status and their risk for non-communicable diseases. BMI usually interpret as an index of an individual's fatness but it does not differentiate between body lean mass and body fat mass and it also does not capture body fat location (Nuttall 2015). Waist circumference is significantly associated with abdominal subcutaneous and visceral fat. Seven *et al.* (2016) and Chandra *et al.* (2014) found that the incidence of hypertension associated with visceral fat but not with subcutaneous adiposity and total body fat. It is well known that women and men have a different proportion of body fat and its distribution. White and Tchoukalova (2014) in their review stated that women have more subcutaneous fat than men and in contrast men have higher visceral fat than women.

Indonesian Basic Health Survey showed that women had higher prevalence of overweight (32.9%) than men (overweight 19.7%) (MoH 2013), nonetheless the prevalence of hypertension was higher in men than women. This conflicting result were different with Lands-

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berg *et al.* (2013) which found that higher BMI increasing the risk of hypertension. Indonesian Basic Health Survey also revealed that overweight prevalence was significantly higher in urban areas than rural areas but the prevalence of hypertension was almost the same (MoH 2013). To our knowledge, there are studies about hypertension risk factors (Peltzer & Pengpid 2018, Singh *et al*. 2017), body composition and blood pressure (Chandra *et al.* 2014, White & Tchoukalova 2014; Seven *et al.* 2016) but few study about it in Indonesia (Peltzer & Pengpid 2018, Sari *et al.* 2016) particularly in rural area. Therefore this study aims to analyse the risk factors of hypertension among adult at rural Indonesia.

## METHODS

### Design, location, and time

This cross-sectional research was conducted in Sukamantri Village (Karang Tengah Subdistrict) and Cisalak Village (Cibeber Subdistrict), Cianjur District, West Java in 2014. The study population was married couples aged 45-59 years old residing in Cianjur District. The sample was selected using simple random sampling among married couples aged 45-59 years old that agreed to be measured (total 224 samples consisted of 112 men and 112 women). The ethical clearance was obtained from the ethical committee of Public Health Faculty, University of Diponegoro, Semarang, Indonesia (No.306/EC/FKM/2014).

### Data collection

Variables in this study are body composition and blood pressure. Anthropometric measurements were done in the morning (07.00-10.00) at village hall. Samples were given 10-15 minutes of rest since arriving at village hall before all the measurement (height, waist circumference, body weight, fat composition, and blood pressure) were performed. Blood pressure was measured by an automatic blood pressure monitor (OMRON® Automatic Blood Pressure Monitor Model HEM-7200). Body height was measured by using a stadiometer with a capacity of 200 cm and an accuracy of 0.1 cm. The waist circumference was measured by using a measuring tape with a capacity of 150 cm and an accuracy of 0.1 cm. The measurement of body weight and fat composition used Bioelectrical Impedence Analysis (BIA) monitor (OMRON® Karada Scan Body Composition Monitor HBF-358-BW).

### Data analysis

Based on WHO (2011) BMI was classified into 4 categories (underweight [<18.5 kg/m$^2$], normal [18.5-24.9 kg/m$^2$], overweight [25-29.9 kg/m$^2$], and obesity [≥30 kg/m$^2$]). Meanwhile, waist circumference divided into 2 groups (normal ≤80 cm for women, ≤90 cm men; and high risk >80 cm women, >90 cm men). Visceral fat allocated into 3 groups (normal [0-9.5], high [10.0-14.5], and very high [≥15]) (OMRON 2017). There was one mising case because unreadable result visceral fat. Total body fat categorised into 4 categories for man (M) and woman (W) (low [M<13; W<25], normal [M=13-23.9; W=25-34.9]; high [M=24-28.9; W=35-40.9]; very high [M≥29; W≥41]) (Gallagher *et al.* 2000). Based on Joint National Committee VII 2003 (NHLBI 2004), blood pressure was classified into normal (<120/<80 mmHg), prehypertension (120-139/80-89 mmHg), stage 1 hypertension (140-159/90-99 mmHg), and stage 2 hypertension (≥160/≥100 mmHg). The association of variables were analyse by Chi-square. Logistic regression was done to analyse the risk factors of hypertension.

## RESULTS AND DISCUSSION

The subjects of this study were men and women aged 40-59 years old. Table 1 discovered that men subjects were older than women subjects. BMI was used to predict nutritional status. Women had a higher proportion of overweight (61.1% vs 38.9%), obesity (85.7% vs 14.3%), and waist circumference (80.9% vs 19.1%) than men. Women also have a slightly higher proportion of total body fat, visceral fat, and hypertension but not significantly associated.

BMI was determined by ratio of weight (kg) and height in meter square (m$^2$). Table 1 showed that women significantly have a higher BMI than men ($p<0.05$). In this study, the high BMI in women was caused by the difference in height rather than weight compared to men. Women are shorter than men but their weight are similar. Women waist circumference ($p<0.05$) were also significantly higher than men. Meanwhile, total body fat, visceral fat, and hypertension status were not different between men and women.

This study revealed that women had a significantly higher proportion of BMI and waist circumference than men. Prospective cohort study

Table 1. Subject distribution by age, body composition and hypertension

| Variables | Men n (%) | Women n (%) | p* |
|---|---|---|---|
| Age (years old) | | | |
| 40-49 | 22 (24.7) | 67 (75.3) | 0.000 |
| 50-59 | 90 (66.7) | 45 (33.3) | |
| Body Mass Index (kg/m$^2$) | | | |
| Underweight (<18.5) | 12 (54.5) | 10 (45.5) | 0.005 |
| Normal (18.5-24.9) | 77 (57.5) | 57 (42.5) | |
| Overweight (25-29.9) | 21 (38.9) | 33 (61.1) | |
| Obesity (≥30) | 2 (14.3) | 12 (85.7) | |
| Waist circumference (cm) | | | |
| Normal (≤80 women; ≤ 90 men) | 94 (72.3) | 36 (27.7) | 0.000 |
| High risk (>80 women; >90 men) | 18 (19.1) | 76 (80.9) | |
| Total body fat (%) | | | |
| Low (M <13; W<25) | 14 (56) | 11 (44) | 0.204 |
| Normal (M:13-23.9; W:25-34.9) | 68 (54) | 58 (46) | |
| High (M:24-28.9; W:35-40.9) | 22 (37.9) | 36 (62.1) | |
| Very high (M≥29; W≥41) | 8 (53.3) | 7 (46.7) | |
| Visceral fat | | | |
| Normal (0.0-9.5) | 75 (47.5) | 83 (52.5) | 0.546 |
| High (10.0-14.5) | 27 (56.3) | 21 (43.8) | |
| Very high (≥15.0) | 9 (52.9) | 8 (47.1) | |
| Hypertension (systol/diastol) (mmHg) | | | |
| Normal (<120/<80) | 19 (55.9) | 15 (44.1) | 0.289 |
| Prehypertension (120-139/80-89) | 44 (55.0) | 36 (45.0) | |
| Stage 1 hypertension (140-159/90-99) | 26 (50.0) | 26 (50.0) | |
| Stage 2 hypertension (≥160/≥100) | 23 (39.7) | 35 (60.3) | |

*Chi-square test

by Sudikno *et al*. (2018) also found that women have a greater risk of developing obesity than men. This study support the result of Ranasinghe *et al.* (2013) which found that BMI are strongly correlated with body fat percentage and this correlation was influenced by age and gender. Nuttal (2015) stated that BMI was a weak predictor of body fat because it cannot differentiate the body fat mass with lean body mass. The fat location in the body can give an important information about the health risk compared to just having knowledge about the quantity of total body fat. More research is needed to measure body composition using gold standard tools such as A Dual-energy X-ray Absorptiometry (DEXA or DXA) which provides the location of body fat depots that may explain whether BMI can be a predictor of total body fat.

Men and women have a different pattern in fat deposition, fat mobilization, and fat utilization as a metabolic fuel and its health consequences. Naturally women store more fat than men. Women have more subcutaneous fat and store fat in hips and thighs. Meanwhile, man deposit their fat in stomach area particularly as a visceral fat. Hormonal differences, reproduction process, pregnancy and lactation caused differences in fat storage and fat utilization between men and women (Shi & Kumar 2012). In this study we found that BMI and waist circumference women were significantly higher than men but the total body fat and visceral fat were the same. It can be caused by the shifting in fat deposition in women from subcutaneous area to visceral area particularly in menopausal women (Shi & Kumar 2012).

Sex hormone has an important role in lipolysis dan fat uptake. Estrogen can reduce visceral fat in men and women meanwhile androgen decreasing visceral fat in men but increasing it in women. Therefore menopausal status can affect total body fat. Women who experience menopause have more body fat (Shi & Kumar 2012). This condition was associated with decreased of estrogen and insulin sensitivity (Palmer & Kirkland 2016). Reduction in estrogen receptor alpha (ERα) gene expression in premenopausal obese women can cause increased body fat. Decreasing endogenous estrogen in menopausal women can

affect the shifting of fat distribution from subcutaneous area to visceral area. The polymorphisms of ERα can interfere the estrogen signaling and causing the increase of visceral fat (Shi & Kumar 2012). This causes higher risk of metabolic syndrome and insulin resistance (Palmer & Kirkland 2016).

Hypertension is defined as systolic and or diastolic blood pressure ≥140/90 mmHg. High prevalence (49.1%) of hypertension was found in this study and women have a higher prevalence than men (54.5% vs 43.7%). Table 1 also showed a greater proportion of stage 2 hypertension in women compared to men (60.3% vs 39.7%). Meanwhile, the proportion of normotension and prehypertension were higher in men than women. The proportion of stage 1 hypertension was similar between men and women. Chi-square showed that there was no significant association of blood pressure with gender (p>0.05).

Table 2 discovered that subject characteristics (sex and age) were not significantly associated with hypertension and not a risk factors for hypertension (Table 3). This results was not in line with Dogan *et al.* (2012) which found that age and gender were risk factors for hypertension. This difference can be caused by the age range of the subjects. This study only involved middle age population (40-59 years old) therefore have a short age range. Choi *et al.* (2017) found that sex differences in hypertension prevalence were shown after the age of 60.

BMI, waist circumference, total body fat, and visceral fat were significantly associated with hypertension (Table 2). After the variabels were analysed by logistic regression (Table 3), they were not significant risk factors for hypertension. Nuttal (2015) revealed that fat location particularly body fat depots location gave more important information about health risk than the total body fat. Furthermore, BMI cannot differentiate the body fat mass with lean body mass so it is a weak predictor of body fat.

Table 3 showed that men with waist circumference >90 cm and women >80 cm were 4 times more likely to get hypertension than those who have normal waist circumference (OR=4.005; 95%CI:1.47-10.914 for high risk). Study Rao and Parab-Waingankar (2013) in India found that waist circumference was a better predictor for obesity related health risk particularly hypertension in both sexes than BMI. This study also in line with Battie *et al*. (2016) which stated that Asian waist circumference threshold for women (>80 cm) can be a prediction for hypertension and diabetes. Therefore, waist circumference can be used as a simple screening tool in assesing the risk of hypertension. The limitation of this study was it did not measure other variables that affect blood pressure such as sodium intake,

Table 2. Association between subject characteristics and body composition with hypertension

| Variables | Non hypertension n (%) | Hypertension n (%) | p* |
|---|---|---|---|
| Sex | | | |
| Men | 43 (38.4) | 69 (61.6) | 0.064 |
| Women | 30 (26.8) | 82 (73.2) | |
| Age (years old) | | | |
| 40-49 | 33 (37.1) | 56 (62.9) | 0.244 |
| 50-59 | 40 (29.6) | 95 (70.4) | |
| Body Mass Index (kg/m$^2$) | | | |
| Not overweight (< 25) | 59 (37.8) | 97 (62.2) | 0.011 |
| Overweight & obesity (≥25) | 14 (20.6) | 54 (79.4) | |
| Waist circumference (cm) | | | |
| Normal (≤ 80 women; ≤ 90 men) | 57 (43.8) | 73 (56.2) | 0.000 |
| High Risk (>80 women; >90 men) | 16 (17) | 78 (83) | |
| Total body fat (%) | | | |
| Normal (M<24; W<35) | 58 (38.4) | 93 (61.6) | 0.008 |
| High (M≥24; W≥35) | 15 (20.5) | 58 (79.5) | |
| Visceral fat | | | |
| Normal (<10) | 58 (36.7) | 100 (63.3) | 0.028 |
| High (≥10) | 14 (21.5) | 51 (78.5) | |

*Chi-square test

Table 3. Risk factors of hypertension

| Variables | B | Sig. | OR (95% CI)* |
|---|---|---|---|
| Sex [1=women; 0=men] | 0.212 | 0.604 | 1.236 (0.555-2.753) |
| Age [1=50-59; 0=40-49] (years old) | 0.651 | 0.066 | 1.917 (0.958-3.838) |
| Waist circumference [1=high risk; 0=normal] (cm) | 1.388 | 0.007 | 4.005 (1.47-10.914) |
| Body Mass Index [1=BMI≥25; 0=BMI<25] (kg/m$^2$) | -0.289 | 0.610 | 0.749 (0.246-2.275) |
| Total body fat [1:high; 0:normal] (%) | -0.094 | 0.847 | 0.91 (0.349-2.371) |
| Visceral fat [1=high (≥10.0); 0=normal (<10)] | 0.515 | 0.300 | 1.674 (0.632-4.437) |

*Logistic regression; M= Men; W=Women ; waist circumference: 1=high risk (M>90 cm; W>80 cm); 0=normal (M≤90 cm; W≤80 cm); total body fat: 1=high (M≥24; W≥35); 0=normal (M=<24; W=<35)

menopausal status, physical activity, smoking habit, stress, diabetes, and cholesterol.

## CONCLUSION

This study revealed that the prevalence of hypertension among adult in rural Indonesia was high in both sexes. Adult with hypertension have higher BMI, waist circumference, total body fat, and visceral fat. In addition, women had a higher prevalence of overweight, obesity, and central obesity. Waist circumference became a risk factor for hypertension. Adults with high waist circumference had 4 times greater chance of getting hypertension compared normal waist circumference. This implied that adults, particularly women need more attention to maintain their healthy body weight and monitor their blood pressure regularly to prevent the increasing health risks of hypertension.

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