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Original Article

Body Composition and Its Related to Hypertension in Elderly: A Cross-Sectional Study from Surakarta

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Abstract

Background : Several studies reported that obesity was linked to abnormal blood pressure. Obesity increases cardiovascular disease risk in adults and elderly. Body composition has been commonly measured using basic anthropometry, i.e body mass index (BMI). However, waist circumference (WC) is assumed to be more capable of capturing long-term visceral fat accumulation than BMI. Studies comparing BMI and WC to the risk of hypertension in the elderly are needed. The aim of this study was to compare the risk of body composition using body mass index and waist circumference as risk factors for hypertension in the elderly.
Methods : A cross-sectional study was carried out in Surakarta, Central Java. A sample of 91 elderly was selected by convenience sampling. The dependent variable was hypertension. The independent variables included age, gender, body mass index (BMI), and central obesity (assessed by waist circumference). BMI and central obesity were used to measure body composition. Blood pressure was measured by a sphygmomanometer, body weight was measured by digital scale (kg), and body height was measured by stature meter (cm). Central obesity was categorized by waist circumference (WC in centimeter) measurement. The other variables were obtained from questionnaire. Comparison of body composition on hypertension were examined using simple logistic regression run on Stata 13.
Results : Elderly with central obesity (waist circumference ≥94 cm for males or ≥80 cm for females) had higher risk hypertension and it was statistically significant (OR= 3.07; 95% CI= 1.10 to 8.53; p= 0.032).
Conclusion : Central obesity is significantly increase the risk hypertension in elderly.

Keywords : body composition, body mass index, elderly, hypertension, waist circumference

INTRODUCTION

Body mass index (BMI) is the most common anthropometric measurement for assessing obesity.[1] However, there have been many studies that recommend not only using BMI as an indicator of cardiovascular health risk. It is because measuring BMI alone can result in misclassification and understate the possibility of populations at risk. For example, individuals with normal weight sometimes have central obesity.[2]

Ideally, direct measurement of abdominal fat uses imaging techniques such as computed tomography scanning and magnetic resonance imaging.[3] However, this gold standard technique is expensive, time-consuming, and impractical when carried out in resource-limited environments and during large-scale epidemiological surveys.[4]

Previous studies suggested the assessment of central obesity to assess cardio-metabolic risk, including hypertension.[5,6] Recent studies have shown the ability to measure proxies for anthropometric indicators such as waist circumference (WC), waist-hip ratio (WHR), and waist-to-height ratio (WHTR) to examine the distribution of central obesity.[7] However, previous studies have focused on adolescents and adults populations and studies in the elderly group are relatively sparse.

The purpose of this study was to compare the risk of body composition using body mass index and waist circumference on hypertension in elderly.

METHODS

Study design

This was an analytic observational study with a cross sectional design. The study was carried out at the elderly integrated health posts (posyandu) in Surakarta, Central Java, Indonesia, from August to September 2022.

Population and sample

The study population was elderly aged ≥60 years. We employed a convenience sampling method to select participants. They were recruited from four local elderly integrated health posts (posyandu) in Surakarta. 91 elderly who visit the elderly "posyandu" was selected for this study. Older people who are not physically capable to undergo standing height measures or weight measures were then excluded to execute a sensitivity analysis.

Study variables

The dependent variable was hypertension. The independent variables were age, gender, body mass index (BMI), and central obesity.

Blood pressure was measured using sphygmomanometers. Hypertension was defined according to World Health Organization, using the following criteria: (1) Normal: SBP less than 120 and DBP less than 80mmHg; (2) elevated hypertension: SBP 120 to 129 and DBP less than 80mmHg; (3) Stage 1 hypertension: SBP 130 to 139 or DBP 80 to 89mmHg; and (3) Stage 2 hypertension: SBP ≥140 mmHg or DBP ≥90 mmHg.[8]

Body weight was measured using digital weight scale and body height was measured using stature meter. BMI and central obesity were used to measure body composition. Body mass index (BMI) is calculated as body weight (kg)/height (m^2). BMI is categorized according to WHO classification as underweight (BMI <18.5), normal (BMI 18.5–24.9), overweight (BMI 25.0–29.9), and obese (BMI >30.0).[9]

Central obesity was assessed by waist circumference. Waist circumference (WC) was measured at the level of the narrowest point between the lower costal margin and the iliac crest at the end of a normal expiration with the arms relaxed at the sides. Central obesity is defined according to WHO criteria (WC >94 cm for men and >80 cm for women).[1]

Data collection

The data were collected during routine medical check-up in the elderly health post in Surakarta. Anthropometric measurements, including body weight, height, and waist circumference were performed to all participants

Data analysis

Descriptive analyses were expressed as means, standard deviation (SD), absolute frequency, and percentage. T-test and Chi-square were used to determine the differences between gender in the variables. Simple logistic regression analyses were used to determine the association between the anthropometric indicators (i.e., BMI and WC) and hypertension. In all statistical evaluations, the significance level was set at $p < 0.05$. The data analysis run on Stata 13.

Research ethics

This study was approved by the Research Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta, Central Java, Indonesia (number: 4333/B.2/KEPK.FKUMS/VI/2022). All participants signed a written informed consent.

RESULTS

Table 1 showed that the study participant's age ranged from 60 to 91 years, with a mean (SD) of 64.53 (8.16) years. Mean of systolic blood pressure was 141 mmHg (SD= 23.79) and diastolic blood pressure was 85.8 mmHg (SD= 13.19). Mean of body mass index was 25.6 kgBW/m^2. Mean of waist circumference was 95.7 cm (SD= 19.40).

Table 2 showed the overall percentage of pre-hypertension, hypertension stage 1, and hypertension stage-2 were 28.57%, 32.97%, and 15.38%, respectively. Majority (71.43%) of the elderly was female; (83.52%) did

TABLE 1
Sample characteristics of continous data

Study Variables	n	Mean	SD	Min.	Max.
Age (year)	91	64.5	8.16	60	91
SBP (mmHg)	91	141.0	23.79	94	225
DBP (mmHg)	91	85.8	13.19	61	128
Body weight (kg)	91	59.4	11.17	36	85
Body height (cm)	91	152.3	7.31	136	175
BMI (kgBW/m^2)	91	25.6	4.42	16.41	37.44
WC (cm)	91	95.7	19.40	70	195

* SBP= systolic blood pressure; DBP= diastolic blood pressure; BMI= body mass index; WC= waist circumference

TABLE 2
Sample characteristics of dichotomous data

Study Variables		n	%
Gender	Female	65	71.43
	Male	26	28.57
Smoking	No	76	83.52
	Yes	15	16.48
Body mass index	Thin	3	3.30
	Underweight	1	1.10
	Normal	35	38.46
	Overweight	21	23.08
	Obesity	31	34.07
Central obesity*	No	26	28.57
	Yes	65	71.43
Hypertension	Normal	21	23.08
	Pre-hypertension	26	28.57
	Hypertension stage 1	30	32.97
	Hypertension stage 2	14	15.38

*Central obesity: WC ≥94 cm for male and WC ≥80 cm for female

not smoke; and (71.43%) had high waist circumference (central obesity). A third of the participant had hypertension stage-1 (32.97%).

Table 3 showed the differences in the characteristics of study variables based on gender. Table 3 showed that the mean of systolic blood pressure (mmHg) in women (Mean= 139.8; SD= 22.39) was lower than male (Mean= 144.3; SD= 27.18). Mean of diastolic blood pressure (mmHg) in women (Mean= 84.2; SD= 13.39) was lower than male (Mean= 89.7; SD= 12.03). There was no difference of body mass index between male (Mean= 25.5; SD= 4.40) and female (Mean= 25.9; SD= 4.56), p= 0.69. There was no difference of waist circumference between male (Mean= 94.9; SD= 17.89) and female (Mean= 97.5; SD= 23.05), p= 0.57.

This study found that normal weight (OR= 4.36; 95% CI= 0.36 to 53.39; p= 0.25), overweight (Or= 12; 95% CI= 0.81 to 177.44; p= 0.071), and obesity (OR= 10.4; 95%

TABLE 3
Difference between gender in study variables

Study Variables	Female (n= 65)		Male (n= 26)		p
	Mean	SD	Mean	SD	
SBP (mmHg)	139.8	22.39	144.3	27.18	0.42
DBP (mmHg)	84.2	13.39	89.7	12.03	0.08
BMI (kgBW/m^2)	25.5	4.40	25.9	4.56	0.69
Central obesity (WC, cm)	94.9	17.89	97.5	23.05	0.57

TABLE 4
Simple logistic regression between body mass index and hypertension in elderly (n= 91)

Body mass index	OR	95% CI		p
		Lower limit	Upper limit	
Underweight	Ref.			
Normal	4.36	0.36	53.39	0.25
Overweight	12.0	0.81	177.44	0.071
Obesity	10.4	0.78	137.83	0.076

TABLE 5
Simple logistic regression between central obesity and hypertension in elderly (n= 91)

Central obesity	OR	95% CI		p
		Lower limit	Upper limit	
No	Ref.			
Yes	3.07	1.10	8.53	0.032

*Central obesity= WC ≥94 cm in male and ≥80 cm in female

CI= 0.78 to 137.83; p= 0.076) were not significantly associated with hypertension in elderly (Table 4).

Table 5 reported that elderly with central obesity (waist circumference ≥94 cm in male and ≥80 cm in female) had higher risk of hypertension than those without central obesity (Or= 3.07; 95% CI= 1.10 to 8.53; p= 0.032).

DISCUSSION

Current study was designed to evaluate the effect of body mass index and central obesity on hypertension. Using a simple logistic regression on a conceptual model, the authors found that central obesity (waist circumference measurement) was associated with hypertension in elderly.

Hypertension is a common problem among the elderly, with increasing prevalence, and is associated with the risks of several non-communicable diseases.[10] Excess weight gain is long recognized as a significant cause of hypertension, contributing to about 78% of the risk for primary hypertension in men and 65% in women.[11,12] The prevalence of obesity is rising in elderly individuals.[13] Obesity is one of the modifiable risk factors associated with cardiovascular disease.[14] As an individual grow older, body composition changes with respect to fat distribution and height estimation.[15] Intra-abdominal fat has been shown to increase with age across both cross-sectional and longitudinal studies.[16,17] High intra-abdominal fat are commonly hypothesized had correlation with insulin resistance, which leads to type 2 diabetes and cardiovascular disease.[17]

Nowadays, BMI has been widely used for defining total obesity and has been observed to have a relationship with cardiovascular disease-specific mortality and all-cause mortality.[18,19] However, many studies reported BMI inability to reflect body fat distribution has limited its application in evaluating obesity-related cardiovascular risk because of the heterogeneous nature of obesity. While fat mass increases and redistributes, lean mass simultaneously tends to decrease with age, mostly as a consequence of sarcopenia.[17,20] The cut-off values of the obesity indices have not been defined for the elderly population because sarcopenia causes loss of muscle mass and fatty tissues increase with ageing.[21,22] Ageing and sarcopenia cause muscle loss and increase fat deposition, making BMI an inaccurate reference.[23]

Recent studies reported that visceral fat has a closer association with metabolic abnormalities compared with subcutaneous fat.[24–26] As the central component of the metabolic syndrome, abdominal obesity tends to aggregate with hypertension and other cardiometabolic risk factors.[27] Central adiposity has been seen to be more appropriated as a predictor of metabolic risk than BMI and its simple measurement can be done through WC.[28] A study in Brazil found that the risk of hypertension was higher with increasing waist circumference and age.[29] A cohort study by Cai *et al*.[30] found that abdominal obesity measured by WC or WHR had higher discriminative ability than BMI or body weight alone in predicting diabetes mellitus, high fasting plasma glucose, or other metabolic syndrome among elderly Spanish.

This study resulted that high body composition, categorized as overweight or obese (total obesity or central obesity), had higher risk to hypertension in elderly. Current finding supports that body mass index or waist circumference measurement should be implemented by the health professionals as hypertension disease preventive program in elderly. Further research needed to compare which is the best index as a predictor of hypertension, body mass index or waist circumference.

CONCLUSION

This study concluded that central obesity increase the risk for hypertension in elderly.

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Conflict of interest

All authors have nothing to disclose.

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