

## Correlation between wrist circumference with blood pressure and creatinine level among elderly

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### ABSTRACT

**Background:** Hypertension is a highly prevalent health problem which incidence is greatest among the elderly. Hypertension may increase creatinine level and leads to other health problems like diabetes mellitus, kidney damage, and cardiovascular disease. Wrist circumference is a simple anthropometric measurement that can be used to identify hypertension and increasing level of serum creatinine.

**Objectives:** To analyze the correlation of wrist circumference with blood pressure and creatinine level among the elderly.

**Materials and Methods:** This was a cross-sectional study with a purposive sampling method. Subjects of this study were 84 women aged 60 years old or above at Unit Rehabilitasi Sosial Pucang Gading Semarang. The independent variable of this study was wrist circumference, and the dependent variables were systolic blood pressure, diastolic blood pressure, and creatinine level. The result was analyzed using the Spearman-rho test.

**Results:** The participants of this research were 49% women aged 60-65 years old, with an average age was 65.5 years old. The prevalence of hypertension was 61.9%. Most hypertension incidence in this research was caused by high systolic blood pressure (50%), and the rest was caused by high diastolic blood pressure (3.9%) and both (46.1%). The level of creatinine was normal with an average level was 0.75 mg/dL. There was no correlation of wrist circumference with systolic blood pressure systolic ( $r=0.15$ ;  $p=0.19$ ), diastolic blood pressure ( $r=0.1$ ;  $p=0.38$ ), and creatinine serum ( $r=0.18$ ;  $p=0.09$ ) among elderly.

**Conclusions:** There was no correlation of wrist circumference with blood pressure and creatinine level among the elderly.

**Keywords:** Wrist circumference; Blood pressure; Creatinine level; Elderly

### BACKGROUND

According to World Health Organization (WHO), the elderly are individuals with the chronological age of 60 years or more. The Elderly is the last phase of the human life cycle and is initiated by the aging process. This aging process is contributing to frailty which posing the elderly to diseases, both infectious and non-infectious ones.<sup>1</sup> Elderly population in Indonesia is 9.7% based on Riskesdas 2019 and was predicted to be increased more than 2 folds in 2050. Based on Riskesdas 2018 data, the most prevalent disease for the elderly in Indonesia is hypertension.<sup>2</sup>

Hypertension is a condition in which a person has systolic blood pressure  $\geq 140$  mmHg and/or diastolic blood pressure  $\geq$  of 90 mmHg.<sup>3</sup> Hypertension increase the risk of diabetes and coronary heart disease. Moreover, hypertension

could lead to chronic kidney disease through the increased blood creatinine level.<sup>4</sup> Prevalence of hypertension in Indonesia is 34.1% where 59.4% of citizens with the age of  $>54$  years are having hypertension.<sup>2</sup> Hypertension prevalence in Central Java is 37.6%, even higher than national prevalence.<sup>5</sup> Health Department of Central Java stated hypertension prevalence in Semarang City in 2018 is 6.3%, whereas much as 14.9% of the citizen with the age of  $>45$  years are having hypertension.<sup>6</sup>

Hypertension is preventable and treatable by early detection. Hypertension is usually detected by performing a blood pressure examination using a sphygmomanometer. However, a simple anthropometry measurement that is quick and easy could be considered as a parameter to detect hypertension, one of them is wrist circumference.<sup>7-9</sup> Measurement of waist circumference is easier to be

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done since it does not require ratio calculations and trained individuals.<sup>10</sup> Inflammation state in hypertension indirectly decreases the bone mineral density, including on wrist circumference.<sup>9</sup>

Besides as a predictor of hypertension, many studies show the correlation between waist circumference and creatinine levels. A large-scale study conducted on 2.400 respondents in Iran shows that simple anthropometric measurement as wrist and neck circumference has a significant correlation with creatinine level and able to predict the risk of chronic kidney disease in adolescents and adults.<sup>11</sup>

The population-based study associated with the correlation between waist circumference with blood pressure and creatinine levels in Indonesia is still limited, especially among the elderly in Semarang City. The purpose of this study is to analyze whether waist circumference is associated with blood pressure and creatinine levels among the elderly.

## MATERIALS AND METHODS

This study is an observational study with a cross-sectional design among 84 elderly in Unit Rehabilitasi Sosial Pucang Gading Semarang from May to July 2019. Samples were collected via the purposive sampling method. Institutional Review Board of Ethical Clearance (*Komisi Etik Penelitian Kesehatan/KEPK*) from the Medical Faculty of Diponegoro University has approved this study and publish ethical clearance 141/EC/FK-RSDK/1V/2018.

Inclusion criteria in this study are women with the age of 60 years or more, communicative, and willing to be involved in this study by signing informed consent. Exclusion criteria are the history of/currently taking long-term corticosteroid medication, routinely consuming calcium supplements, and having chronic diseases such as diabetes, kidney failure, liver disease, gastrointestinal disturbance, and thyroid dysfunction.

The dependent variable in this study is wrist circumference. Wrist circumference measurement was performed using measuring tape with 0,1 cm accuracy. The measuring tape was wrapped around the wrist from the Lister tubercle on the distal radius to the distal ulnae on the right hand in a sitting position. The independent variables are blood pressure and creatinine level. Blood pressure measurement was performed twice using a digital sphygmomanometer. Blood sampling was performed by laboratory personnel and creatinine levels were

tested using a photometer automatic chemistry analyzer.

Data analysis was performed using the computer-based statistic program SPSS, consisting of univariate and bivariate analysis. Univariate analysis was performed to describe the subject's characteristics such as age, body mass index (BMI), blood pressure, and creatinine levels. Bivariate analysis was performed to analyze the correlation between waist circumference with blood pressure and creatinine levels by the Spearman correlation test. Coefficient correlation ( $r$ ) approaching 0 shows a weak correlation among variables and  $r$  value approaching -1 or 1 shows a strong correlation.  $P$ -value  $<0.05$  shows a significant correlation between variables.

## RESULTS

Table 1 shows the anthropometry and biochemistry characteristics of the subjects in this study. Based on Table 1, most of the subjects are 60-65 years old (58.3%) with an average of 65.5 years old. Forty-three subjects (51.2%) are obese.

The prevalence of hypertension in this study is 61.9%. As much as 50% of hypertension in the subjects of this study is marked by high systolic pressure. Hypertension with high diastolic blood pressure is only 3.9% and the rest (46.1%) is caused by high systolic and diastolic blood pressure. The biochemical test shows creatinine levels on most subjects are still in the normal range with an average of 0.75 mg/dL.

Table 2 shows the correlation between waist circumference and systolic blood pressure, diastolic blood pressure, and creatinine level to analyze the strength and direction of the variables.

Statistical analysis shows there is no correlation between waist circumference and systolic blood pressure, diastolic blood pressure, and creatinine level with a  $p$ -value  $> 0.05$ .

## DISCUSSION

The prevalence of hypertension in this study, whether based on systolic or diastolic blood pressure or both, is 61.9%. This result is in accordance and able to show highly prevalent hypertension among the elderly in Indonesia that reach 59.4% in 2018.<sup>2</sup> This number shows the importance of a quick and good indicator to detect hypertension.

Previous studies show that waist circumference correlated with hypertension and increased creatinine level.<sup>11-13</sup> One of the factors influencing bone growth is a hormone called insulin-like growth factor 1 (IGF-1). This hormone is

stimulated by growth hormone and synthesized in the liver. Insulin-like growth factor 1 stimulates nitric oxide (NO) formation by endothelial cells and cells in blood vessels smooth muscle and stimulates Na-K-ATPase pump, therefore causing blood

vessels relaxation and decrease blood pressure.<sup>14,15</sup> Wrist circumference which is one of the indicators of bone surface dimension could be used to predict hypertension risk and increased creatinine level.<sup>16</sup>

**Table 1. Baseline Characteristics**

	Numbers (%)
<b>Total subjects</b>	84
<b>Age (years)</b>	
60 – 65	49 (58.3%)
>65	35 (41.7%)
<b>Body Mass Index (kg/m<sup>2</sup>)</b>	
< 18.5	2 (2.4%)
18.5 – 22.9	30 (35.7%)
23 – 24.9	9 (10.7%)
≥ 25	43 (51.2%)
<b>Systolic Blood Pressure (mmHg)</b>	
Normal	34 (40.5%)
Hypertension	50 (59.5%)
<b>Diastolic Blood Pressure (mmHg)</b>	
Normal	58 (69.1%)
Hypertension	26 (30.9%)
<b>Creatinine Level (mg/dL)</b>	
Normal	80 (95.2%)
High	4 (4.8%)
<b>Wrist Circumference (cm)</b>	15.35 ± 0.14

Note: BMI: Body Mass Index

**Table 2. Correlation between wrist circumference with blood pressure and creatinine level**

Variable	Coefficient correlation (r) <sup>a</sup>	Sig. (p-value)
Systolic blood pressure (mmHg)	0.15	0.19
Diastolic blood pressure (mmHg)	0.10	0.38
Creatinine level (mg/dL)	0.18	0.09

Note: <sup>a</sup>pearman test

Physiologically, aging will cause the thickening and hardening of blood vessels. This condition is associated with chronic inflammation in blood vessels and increased oxidative stress thus decreasing the elasticity of blood vessels and inhibits blood flow. The blocked blood vessels will increase heart workload in pumping blood, therefore increase blood pressure.<sup>17</sup> Blocked blood vessels in the kidney will cause a decreased glomerular filtration rate. This will result in decreased creatinine excretion and the risk of increased creatinine in blood among the elderly.<sup>18</sup>

There was not found a significant correlation between waist circumference with blood pressure and creatinine level in this study. This was presumably caused by the influence of several

factors such as physical activity, food intake, previous history of the disease, and other factors that were not included in this study.

Increased physical activity will decrease the catecholamine level in the blood. This condition will indirectly decrease the sympathetic nervous system which responds to the decreased blood flow rate and vasodilatation.<sup>19</sup> Moreover, blood pressure and creatinine levels are easily influenced by food intake. Elderly with poor food intakes such as consuming high calories food, high sodium, protein, fat and low in potassium and fiber will increase the risk of increased blood pressure and creatinine level.<sup>20-25</sup> High sodium and low potassium food will influence fluid volume and blood vessel elasticity which contribute to increased blood pressure.<sup>20, 21</sup>

High protein intake, especially animal-based protein is associated with hypertension and kidney failure.<sup>22</sup> Fiber is known for its potency in increasing insulin sensitivity and endothelial cells which will contribute to blood vessel elasticity.<sup>23</sup>

High fat and dense calorie food will increase excess caloric intake and fat deposition in blood vessels that will result in blocked blood flow from and to organs, and disturbing its physiological condition.<sup>24, 25</sup> Obesity and hyperglycemia will increase the risk of increased blood pressure and blood creatinine level. Inflammation caused by obesity and hyperglycemia will increase free radicals and decrease adiponectin, and result in the damage and elasticity impairment of the blood vessels.<sup>24,25</sup> This could also increase blood pressure and blood creatinine levels if kidney blood vessels are affected.<sup>17, 18</sup>

## CONCLUSIONS

Wrist circumference is not correlated with blood pressure and creatinine levels in this study. This is presumably caused by several factors such as physical activity, food intake, and previous history of the disease which could influence the correlation between waist circumference with blood pressure and creatinine level.

Further studies should be carried out to validate the correlation between waist circumference with blood pressure and creatinine level among the elderly by considering the food intake and physical activity of the elderly.

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