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Association of Body Composition and Anthropometric Measurement with Hypertension among Workers in Universitas Ahmad Dahlan

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ABSTRACT

Purpose: This study aims to investigate the relationship between anthropometric and body composition measurement with the risk of hypertension among office workers.

Methodology: This study was a cross-sectional study in office workers population in Universitas Ahmad Dahlan. The subjects of the study were 125 persons (72 males and 53 females) aged 20 - 60 years. The measurement of anthropometry was using an electronic digital scale for weight, microtoise for height, and meter line for waist circumference. In analysing body composition such as total body fat and visceral fat, we were using Bioelectrical Impedance Analyzer (BIA) Body Composition Monitor Omron Karada Scan HBF-375. Blood pressure was measured by an automatic blood pressure monitor OMRON HEM-7120. Hypertension was classified if the blood pressure of systolic ≥ 140 and diastolic ≥ 90 . The association between risk factors variables and hypertension status was analysed by chi-square test and multiple logistic regression.

Results: The prevalence of hypertension was found 18.6% in male and 13.21% in female. All risk factors were similar between male and female ($p > 0.05$). Body mass index (BMI), waist to hip ratio (WHR), and total body fat were not statistically significant with hypertension status ($p > 0.05$). The statistically significant risk factors of hypertension only found in waist circumference and visceral fat ($p = 0.036$; $p = 0.002$). Results of multivariate analysis, visceral fat remains significant in predicting hypertension, with 4.87 times higher risk of having hypertension in workers if having high visceral fat (95% CI 1.722-13.7831)

Applications/Originality/Value: This study shows that the prevalence of pre-hypertension and hypertension among workers were high. Thus, controlling modifiable risk factors is very important. Maintain the waist circumference and visceral fat in normal range with proper healthy lifestyle were needed especially in office workers.

Keywords: hypertension, office workers, body mass index, visceral fat, waist circumference

INTRODUCTION

Hypertension is a health problem that has an impact on various diseases. High blood pressure was associated with increased risks of all-cause mortality, Chronic Heart Disease (CHD), stroke, and kidney disease (1). The prevalence of hypertension has continued to increase over the past few years, including in Indonesia (2). Nowadays, hypertension has occurred not only in the elderly but also in younger age and sometimes undetectable, except for people who routinely checked their health status.

Office workers are one of the populations vulnerable to hypertension. Working patterns that sit more increase the risk of obesity. Based on the results of research, workers who sit more than 6 hours per day on risk for obesity compared to those who sit less than 45 minutes per day (3). Higher prevalence of over-nutrition can impact to financial loss of the institution because of higher health cost spending, absenteeism, work hours lost, and worker loss (4,5).

Monitoring health status by weighing frequently was one of the principal messages for Indonesian's Nutrition Balance Guideline 2014. Based on weighing, we can assess body mass index which was one of the risk factors of hypertension. However, there was another anthropometric measurement who were closely related to hypertension, such as the measurements of waist circumference and waist to height ratio (WHR) (6-8). Limitation of anthropometric measurement was it can't distinguish between weight of fat mass and fat-free mass in overall body weight. Moreover, some research also showed that hypertension was also determined by the amount of fat inside the human body (9).

Some of the previous research showed varying result of hypertension risk factors and not specific for workers population (10,11). In this study, we would investigate which indicators of anthropometric and body composition measurement that predict hypertension in workers. We also would analyse which factors that become the strongest predictors of hypertension in workers. Thus, it can be the

reference indicators to prevent and controlling hypertension among workers.

METHODS

Study Design

This study was an observational study with a cross-sectional design. This study was conducted in Universitas Ahmad Dahlan (UAD) Yogyakarta, Indonesian in April - May 2019. This study had already obtained ethical approval from the Research Ethics Committee of Universitas Ahmad Dahlan No: 011904201.

Subjects

The population of this study was all of the employees in all of UAD's campuses who work at least one year. We took sample in every unit of the university. The subjects were chosen by stratified random sampling method, thus it was able to represent the population of 5 campuses at UAD. The inclusion's criteria were not contract employee, not pregnant and breastfeed, and agree to take part the research with signing the informed consent which had been given before joined the research. Subjects were excluded if they reject to continue or not completely follow the procedure of the study.

Study Protocols

Data collection were obtained through questionnaire and direct measurement of anthropometric and body composition. Characteristics of subjects such as age, education level, marital status, working unit, and duration of work were obtained from the questionnaire. Anthropometric measurements in this study were height, weight and waist circumference. Height measurements used a microtoise attached on a flat wall, then the research subjects attach the back of the body namely the heel, calf, buttocks, back, and back of the head just below the measuring instrument in an upright position. Bodyweight measurements using digital scales are done with minimal clothing and do not carry objects that can add weight and in an upright position and foresight. Waist circumference measurements are carried out with a meter line. The subject uses thin clothing. The subject stands tall. The measurement faces the subject by placing the waist circumference meter line on the smallest part horizontally. Measurement of body

composition using the Bioelectrical Impedance Analyzer (BIA) Body Composition Monitor Omron Karada Scan HBF-375. First, the BIA device is turned on then enter age, weight, height, and gender. The subject stands on the BIA tool. Measurement of blood pressure with an automatic blood pressure monitor OMRON HEM-7120. The subject sits quietly, upright, and feet tread on the floor.

Statistical Analysis

Characteristics of subjects (age, education level working duration, working unit, marital status, family history of hypertension) were categorized by sex and analysed by chi-square test by categorization. Result of weight and height measurement was calculated by divided weight by squared height (kg/m^2) to obtain the body mass index (BMI). Nutrition status was categorized from BMI into 4 categories based on Indonesian's classification: underweight (<18.5), normal ($18.5-25.0$), overweight ($25.1-27.0$), and obesity (>27). Waist circumference was classified into normal if in female ≤ 90 cm, male ≤ 90 cm and at risk if female >80 cm, male >90 cm. Waist-to-height-ratio (WHtR) was calculated by divide waist circumference by height and categorized low risk if $\text{WHtR}<0.5$ and high risk if $\text{WHtR}\geq 0.5$ (8). Total body fat was categorized into 4 categories: low, normal, high, and very high. Visceral fat was categorized into 3 categories: normal ($0.5-9.5$), high ($10-14.5$), and very high ($15-30$). Blood pressure measurement divided into 3 categories based on Joint National Committee VII: normal ($<120/<80$), prehypertension ($120-139/80-89$), stage 1 hypertension ($140-159/90-99$), and stage 2 hypertension ($\geq 160/\geq 100$) (12).

All data was collected at MS Excel and analysed with Statistical Program Stata 12. Categorical data were analysed by chi-square test and presented with significance $p<0.05$. Some data that was qualified to enter the multivariate analysis were analysed in multivariate logistic analysis. The data was presented in the table with Beta, p, and odds ratio (OR) with 95% Confidence Interval (95% CI).

RESULTS

Participants Characteristics

Characteristics of subjects were presented in Table 1. Total subjects of this study were 125 people (72 male and 53 female).

Table 1. Subjects characteristics

Variables	Male n (%)	Female n (%)	p
Age (years old)			
≤40	42 (56.76)	32 (43.24)	0.818
>40	30 (58.82)	21 (41.18)	
Marital status			
Single	9 (42.86)	12 (57.14)	0.134
Married	63 (60.58)	41 (39.42)	
Education			
<Diploma/Bachelor	26 (65.00)	39 (45.88)	0.251
≥ Diploma/Bachelor	46 (54.12)	39 (45.88)	
Family history of hypertension			
No	60 (56.07)	47 (43.93)	0.400
Yes	12 (66.67)	6 (33.33)	
Work duration			
≤ 40 hours/week	48 (53.93)	41 (46.07)	0.192
> 40 hours/week	24 (66.67)	12 (33.33)	

* statistically significant ($p<0.05$)

Table 1 (continued). Subjects characteristics

Variables	Male n (%)	Female n (%)	P
48			
Body Mass Index (kg/m²)			
Underweight (<18.5)	1 (25.00)	3 (75.00)	0.347
Normal (18.5-25)	31 (56.36)	24 (43.64)	
Overweight (25.1-27)	29 (56.86)	22 (43.14)	
Obesity (>27)	11 (73.33)	4 (26.67)	
Waist circumference (cm)			
Normal (≤ 90 male, ≤80 female)	34 (58.62)	24 (41.38)	0.830
Risk (> 90 male, >80 female)	38 (56.72)	29 (43.28)	
Waist to Hip Ratio (WHR)			
Normal (<0.5)	15 (50.00)	15 (50.00)	0.334
High (≥0.5)	57 (60.00)	38 (40.00)	
Total body fat (%)			
Low	1 (50.00)	1 (50.00)	0.432
Normal	15 (46.88)	17 (53.13)	
High	32 (65.31)	17 (34.69)	
Very high	24 (57.14)	18 (42.86)	
Visceral fat			
Normal (0.5-9.5)	34 (45.33)	41(54.67)	0.002*
High (10-14.5)	24 (70.59)	10 (29.41)	
Very high (15-30)	14 (87.50)	2 (12.50)	
Hypertension (mm/Hg)			
Normal (<120/<80)	32 (53.33)	28 (46.67)	0.367
Prehypertension (120-139/ 80-89)	27 (60.00)	18 (40.00)	
Stage 1 hypertension (140-159/ 90-99)	10 (76.92)	4 (57.14)	
26 Stage 2 hypertension (≥160/≥100)	3 (42.86)	4 (57.14)	

* statistically significant (p<0.05)

Table 2. Association risk factors of hypertension

Variables	Non-hypertension n (%)	Hypertension n (%)	P
Sex			
Male	59 (81.94)	13 (18.06)	0.465
Female	46 (86.79)	7 (13.21)	
Age (years old)			
≤40	61 (82.43)	13 (17.57)	0.565
>40	44 (86.27)	7 (13.73)	
Duration of work			
≤ 40 hours/week	73 (82.02)	16 (17.98)	0.343
> 40 hours/week	31 (86.89)	4 (11.11)	
31			
Body Mass Index (kg/m²)			
Normal (≤25)	49 (81.67)	11 (18.33)	0.494
Overweight (>25)	56 (86.15)	9 (13.85)	
Waist circumference			
Normal (≤ 90 male, ≤80 female)	53 (91.38)	5 (8.62)	0.036*
At risk (> 90 male, >80 female)	52 (77.61)	15 (22.39)	
Waist to Height Ratio (WHR)			
<0.5	26 (86.67)	4 (13.33)	0.648
≥0.5	79 (83.16)	16 (16.84)	
Total body fat (%)			
Normal	32 (94.12)	2 (5.88)	0.059
High	73 (80.22)	18 (19.78)	
Visceral fat			
Normal	71 (92.21)	6 (7.79)	0.002*
High	34 (70.83)	14 (29.17)	

Mostly of subjects are aged ≤40, married, and education level minimal diploma (p>0.05). Family history of hypertension and work duration > 40 hours/week higher in male subjects (66.67%) than in female (33.33%) and not differ between groups (p>0.05). Result of anthropometric and body composition measurement showed that in male employee the number of over nutrition higher in male than female (overweight 56.86 % and obesity 73.33%). Higher risk of

cardiovascular disease based on waist circumference and WHtR also higher in male (56.72 % and 60.00%). Total body fat also higher in male, so do the visceral fat which was significantly different between male and female (p=0.002).

Risk Factors of Hypertension

Association of risk factors was shown in **Table 2**. Based on research there were two variables that risk factors for

Table 3. Multivariate analysis of hypertension's risk factors

Variables	Model 1			Model 2		
	B	P	OR (95% CI)	B	P	OR (95% CI)
BMI	-0.360	0.485	0.697 (0.253-1.918)	-	-	-
Waist circumference	0.587	0.333	1.799 (0.548-5.903)	-	-	-
Total body fat	0.400	0.650	1.491 (0.265-8.395)	-	-	-
Visceral fat	1.260	0.036	3.525 (1.084-11.461)	1.584	0.003	4.872 (1.722-13-7831)

hypertension. Waist circumference and visceral fat were significantly associated with hypertension ($p=0.036$ and $p=0.002$).²⁴ Gender, age, duration of work, BMI, total body fat were not significantly associated with hypertension ($p>0.05$).

In Table 3 was shown the result of multivariate analysis. BMI, waist circumference, total body fat, and visceral fat were analyzed in multivariate analysis. BMI, waist circumference, and total body fat that has a value of $p>0.05$ then eliminated. Furthermore, the analysis was carried out on visceral fat and the p-value was 0.003, which means that visceral fat was significantly related to hypertension.

DISCUSSION

Office workers have high-risk of overnutrition (overweight and obesity) as one of the risk factors of hypertension because of the higher rate of sit hours and long working hours in the workplace. In most cases, workers had long sitting hours as much as 3 hours/day in average and higher sitting hours related to higher BMI (3,13,14). Beside of BMI, the other indicators of over nutrition⁴¹ was related to hypertension were waist circumference, waist to hip ratio (WHR), waist to height ratio (WHtR), and body composition such as total body fat (TBF) and visceral fat (VF) (6-9).

The findings of this research that the prevalence of normotension were 53.33% in male and 46.67% in female and the remaining were pre-hypertension and hypertension. It means that almost half of respondents is pre-hypertension and hypertension with the prevalence of pre-hypertension higher than hypertension. These findings were similar with Mannocci (15) who also found that prevalence of pre-hypertension in age <45 years was 61.6% and at the older age the prevalence of pre-hypertension were lower, but increase in the prevalence of hypertension. Higher prevalence of hypertension in male than in the older group was the same as the finding of subjects adults in Bangladeshi whether in the rural or urban area (16).

Variables that statistically significant with hypertension among workers were only waist circumference and visceral fat. We found that age, sex, work duration, WHtR, and total body fat were not related to hypertension. These results were different with other research that found that higher BMI, WHR and total body fat had a strong association with hypertension in mining workers (6,17). The difference of the findings because in our study we are different condition in workers, characteristics of body composition, or there were other better indicator such as the research of Oh et al. (18) in Korea that found other indicators that could predict hypertension and other metabolic factors better in normal waist circumference called visceral-to-subcutaneous fat ratio (VSR). There was also, hypertension strongly affected by another risk factors such as nutrition intake especially sodium intake had higher impact to blood pressure than another risk factors because more than half of Indonesian people (52.7%) are categorized as high

sodium intake as described as sodium intake >2000mg/day (19). High sodium intake increases the incidence of hypertension than other factors based on a cohort study in Indonesia (20).

The risk factor of hypertension which was statistically significant was waist circumference and visceral fat. After continued to multivariate analysis, visceral fat was found as the strongest predictor of hypertension in workers. These findings were similar to another study that also found that visceral fat consistently impacts to hypertension (10,18). We can conclude that among workers in this study, visceral fat was the independent determinant of hypertension. This finding similar to other research (21).

Effect of high visceral fat in increasing the risk of hypertension was explained in some research. Sironi et al. (22) stated that early hypertension was correlated with visceral fat. In the Chinese population, visceral fat correlated consistently with hypertension (10).

From the previous research, higher blood pressure was found in subjects with overfeeding diet and correlated with visceral fat only, even though there were body weight and body change (23). The change of blood pressure was controlled by the sympathetic nervous system (SNS) and kidney's regulation by the renin-angiotensin system (RAS). Visceral fat synthesis in the human body can make the amount of angiotensinogen increase that activates RAS and increase the amount of angiotensin II which impacted to adipocytes dysfunction, higher leptin and lower adiponectin, then activate SNS (24).

The limitation of his study was not analysing the nutrition intake that also important as a risk factor of hypertension. A comprehensive discussion would be better if enough data provided to identify modifiable factors to prevent hypertension in workers. Further study needed to explain and identify correlation another risk of hypertension in workers like prospective study.

CONCLUSION

In conclusion, our study showed that the prevalence of pre-hypertension and hypertension were high because almost half of the workers have blood pressure's category above normal. Risk factors of hypertension in workers were high waist circumference and high visceral fat. The strongest association was found in the relation of visceral fat and hypertension. Both of the risk factors were modifiable, so it was needed some intervention control in a normal range. By controlling these risk factors, the risk of hypertension and the following disease also reduce. Thus, the quality of life and productivity in the workplace would increase and lower the burden of worker's institution.

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GENERAL COMMENTS

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EVIDENCE

Choose a variety of credible sources that relate the topic.

ADVANCED	The writing identifies the most appropriate, credible sources that relate to the chosen topic. A sufficient variety of sources is presented.
PROFICIENT	The writing identifies sufficient, credible sources that relate to the chosen topic. A variety of sources is presented.
DEVELOPING	The writing mostly identifies sources that relate to the chosen topic, but some sources may be insufficient and/or lack credibility. A variety of sources may be lacking.
EMERGING	The writing does not identify sources that relate to the topic and/or sources lack credibility. Few sources are present.

SUMMARY

Present summaries of the sources.

ADVANCED	The writing presents accurate, clear summaries of the sources. Each summary thoroughly addresses the main idea and key supporting details.
PROFICIENT	The writing presents accurate summaries of the sources. Each summary includes the main idea and key supporting details.
DEVELOPING	The writing presents summaries of the sources, but summaries may be incomplete and/or inaccurate. Some summaries may be missing the main idea and/or key supporting details.
EMERGING	The writing presents minimal summaries of the sources and/or summaries are missing.

ANALYSIS

Demonstrate analysis and discussion of the sources, and articulate their connections to the topic.

ADVANCED	The writing demonstrates an insightful critical analysis and discussion of the sources. The writing thoroughly examines why sources were selected and how they relate to the topic. The writing draws connections between sources and broader ideas in the topic.
PROFICIENT	The writing demonstrates a critical analysis and discussion of the sources. The writing examines why sources were selected and how they relate to the topic. The writing may draw some connections between sources and broader ideas in the topic.
DEVELOPING	The writing demonstrates some analysis and/or discussion of the sources. The writing attempts to describe why sources were selected and/or how they relate to the topic.

EMERGING The writing demonstrates little to no analysis and/or discussion of the sources. The writing does not describe why sources were selected and/or how they relate to the topic.

CITATION

Produce citations in the standard bibliographic format.

ADVANCED The writing follows the defined bibliographic format to accurately cite the sources. Citations are complete and error-free.

PROFICIENT The writing follows the defined bibliographic format to cite the sources. Citations are complete, but may include minimal errors.

DEVELOPING The writing attempts to follow the defined bibliographic format to cite the sources. Citations may be incomplete and/or include errors.

EMERGING The writing does not follow the defined bibliographic format to cite the sources. Citations may be missing and/or include several errors.

FORMAT

Follow the specified format for the assignment.

ADVANCED The writing adheres to the precise format (i.e. line spacing, indentation, number of entries, entry length, etc.) specified for the assignment.

PROFICIENT The writing generally adheres to the appropriate format (i.e. line spacing, indentation, number of entries, entry length, etc.) specified for the assignment.

DEVELOPING The writing attempts to adhere to the appropriate format (i.e. line spacing, indentation, number of entries, entry length, etc.) specified for the assignment, but strays at times.

EMERGING The writing does not adhere to the appropriate format (i.e. line spacing, indentation, number of entries, entry length, etc.) specified for the assignment.

LANGUAGE

Use domain-specific vocabulary and appropriate language to communicate ideas.

ADVANCED The writing uses precise language and domain-specific vocabulary to discuss the sources. If errors are present, they do not interfere with meaning.

PROFICIENT The writing generally uses precise language and domain-specific vocabulary to discuss the sources. The writing may contain some errors, but they do not interfere with meaning.

DEVELOPING The writing uses some precise language that may be domain-specific at times to discuss the sources. The writing contains some errors that may interfere with meaning.

EMERGING The writing presents general language and is not domain-specific. The writing contains several errors that interfere with meaning.

