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MID-UPPER ARM CIRCUMFERENCE VS BODY MASS INDEX IN ASSOCIATION WITH BLOOD PRESSURE IN YOUNG MEN: A CROSS-SECTIONAL STUDY)

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ABSTRACT

Hypertension and obesity are major risks factor for cardiovascular disease (CVD), which is one of the leading causes of mortality. Many studies have shown that body mass index (BMI) and mid-upper arm circumference (MUAC) measurements are associated with blood pressure in children and adults. However, the association has not been studied extensively in young men. This study aims to investigate the correlation between BMI with blood pressure and MUAC and MUAC with blood pressure in young men. This is a cross-sectional study that consisted of 38 male participants who met the criteria. Blood pressure, BMI, and MUAC were measured using standard procedures. The mean of BMI, MUAC, systolic blood pressure (SBP), and diastolic blood pressure (SBP) was 24.68±4.41 kg/m^2, 30.23±5.45 cm, 117.39±10.47 mmHg, and 75.57±8.44 mmHg, respectively. The Pearson correlation test between the BMI with SBP and BMI with DBP was statistically significant ($p \leq 0.05$) with $r=0.446$ and $r=0.537$, respectively. Contrarily, the MUAC and blood pressure show no significant association. This study concluded a moderate positive correlation of BMI with systolic and diastolic blood pressure in young men subjects.

Keywords: body mass index; cardiovascular disease; diastolic blood pressure; mid –upper arm circumference; systolic blood pressure.

INTRODUCTION

Changes in people's unhealthy lifestyles have triggered a shift in the pattern of diseases that caused deaths. World Health Organization (WHO) data states that non-communicable diseases caused more than 60% or around 36 million deaths that occurred in the world in 2018. A cohort study in America involving thousands of subjects stated that as many as 20.7% of subjects had a heart attack.[1] The incidence of cardiovascular disease (CVD) has also shifted towards younger ages.

Several significant cardiovascular disorders, including hypertension and obesity, are essential factors for CVD and could be served as targets for early identification and prevention. Hypertension is known to be the main risk factor for CVD, particularly in high-risk populations.[2] In the age range of 18-35 years, the incidence of hypertension was 7.9% in women and 9.2% in men. [3] Researchers indicate that BP control is essential to decrease CVD risk. A meta-analysis study revealed that blood pressure reduces 38% of risk factors of stroke and 16% of coronary disease.[4]

Overweight and obesity, which is a modifiable risk factor for hypertension, can be defined by Body Mass Index (BMI) and Mid-upper arm circumference (MUAC) measurements. Body mass index (BMI) is the most widely used anthropometric measurement and is frequently used to estimate the prevalence of obesity within a population. Furthermore, BMI is recommended as a simple measure to identify obesity in children and adolescents.[5] However, BMI can be misleading, such as in

a person with a high proportion of lean muscle. Moreover, a person with central obesity can have a normal BMI. Otherwise, MUAC is often used as an indicator of central obesity. The measurement of MUAC is a simple, inexpensive, quick, and practical method as a screening for obesity.[6] Previous studies have shown that both anthropometric indicators are associated with blood pressure in children and adults. [7,8,9] However, the association between BMI, MUAC, and BP has not been studied broadly in young men. The purpose of the current study was to investigate the correlation between BMI with blood pressure, BMI with MUAC, and MUAC with blood pressure in young men.

MATERIAL AND METHODS

This study was observational with a cross-sectional approach conducted from June to August 2020 at the Physiology Laboratory, Faculty of Medicine, Jenderal Soedirman University. A total of 38 students aged 18-21 years old were included in this study. All participants agreed to participate, following all contained in the informed consent sheet before the study began. After obtaining informed consent, each participant was measured for body mass index (BMI), heart rate (HR), mid-upper arm circumference (MUAC), and blood pressure.

BMI was determined by dividing weight (Kg) by height squared (m^2) and classified according to WHO Asia Pacific classification. The height (cm) and weight were measured to the nearest 0.1 cm and weight (Kg) 0.1 Kg, respectively. The MUAC was measured using tape at the middle of the olecranon and acromion on the upper of the non-dominant arm. All of the anthropometric measurements were performed twice and then averaged for analysis. All of the participants were in minimal clothing and barefoot during anthropometric measurements

Three BP measurements of systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken three times, using an automated sphygmomanometer (OMRON HEM-7156, Omron, Japan). Blood pressure was measured three times after the participant had been seated for 10 minutes and then averaged for analysis. The blood pressure classification is defined according to the JNC 8 classification

Descriptive statistics were presented for age, height, weight, BMI, MUAC, HR, systolic blood pressure, and diastolic blood pressure. The Pearson correlation test was used to assess the relationship between each parameter of BP (SBP and DBP) and anthropometric indicators (BMI and MUAC). The statistical significance was set at $p \leq 0.05$.

RESULT

A total of 38 respondents have participated in this study. The description of participants' characteristics is presented in Table 1. The average age of participants was 19.55±1.08 years, while the average of SBP and DBP were 117.39±10.47 mmHg and 75.57±8.44 mmHg, respectively. Whereas the classification of BMI and Blood pressure was shown in Table 2. The prevalence of prehypertension (JNC 8 classification) of all subjects is 15.8%, and the rest of 84.2% have normal blood pressure. The BMI mean ranges 24.68±24.41 kg/m^2. According to the Asian-pacific classification of BMI, there are 13% obese II, 34% obese I, 18% overweight, 23% normal weight, and 11% underweight of all subjects. Accordingly, the prevalence of obesity in this study was 47%.

Table 1. Characteristics of the study participants (N = 38 subjects)

Variables	Mean±SD
Age (years)	19.55±1.08
Height (cm)	169.18±6.61
Weight (Kg)	70.63±13.87
BMI (kg/m^2)	24.68±24.41
MUAC (cm)	30.23±5.45
SBP (mmHg)	117.39±10.47
DBP (mmHg)	75.57±8.44
HR (bpm)	86.65±13.64

Table 2. Body Mass Index and Blood pressure classification of participants (N=38)

Parameters	N	%
Body Mass Index classification*		
Underweight	4	10.5
Normal	9	23.7
Overweight	7	18.4
Obesity class 1	13	34.2
Obesity class 2	5	13.2
Blood pressure classification**		
Normal	31	84.2%
Prehypertension	7	15.8%
Hypertension	0	0%

Note: *WHO Asia pacific classification; ** JNC 8 classification

The Pearson correlation test between the BMI with SBP and DBP was significant ($p \leq 0.05$) with $r=0.446$ and $r=0.537$, respectively. The correlation between BMI with SBP and DBP shows in Figure 1. This figure shows moderate positive relationships between BMI with SBP and BMI with DBP. As the BMI increases, the value of the SBP and DBP also tends to increase. However, the Pearson correlation test between MUAC with SBP and DBP was not statistically significant ($p \geq 0.05$).

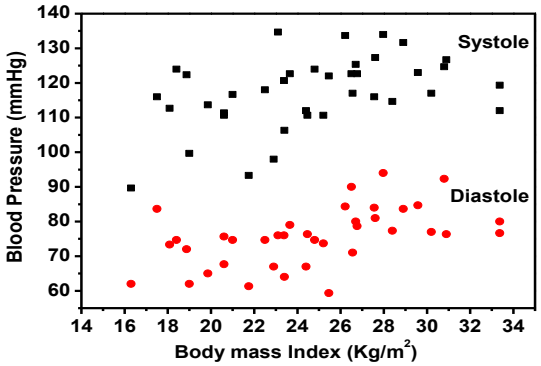

Figure 1. Correlation between Body Mass Index with systolic blood pressure and diastolic blood pressure shows positive relationships

BMI and MUAC consider as anthropometric measurements for estimating obesity. In this study, the Pearson correlation test between the BMI and MUAC was significant ($p \leq 0.05$) and had a positive relationship ($r=0.527$). Figure 2 shows moderate associations between BMI and MUAC

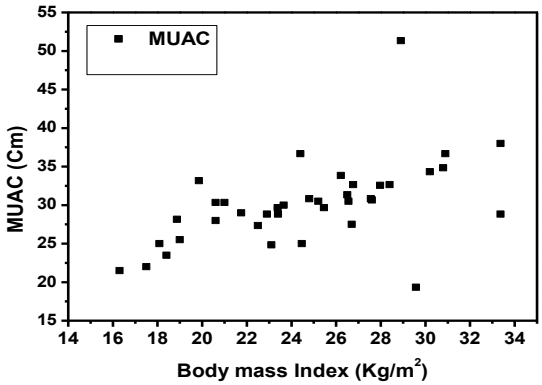

Figure 2. The correlation between Mid-upper arm circumference (MUAC) and Body Mass Index (BMI) shows a positive relationship

DISCUSSION

In this study, we have proved a positive correlation between BMI and Blood pressure but no correlation between MUAC and Blood pressure. The prevalence of obesity in this present study (47%) was higher than in Indonesia, which 33.5% in adults ≥ 18 years in 2016. Furthermore, the prevalence of hypertension in this study also did not represent national or international prevalence. The prevalence of hypertension in people aged ≥18 years in Indonesia is 25.8%. The brief data from the National Center for Health Statistics stated that the prevalence of hypertension among adults aged 18–39 was 33.2%.[3]

The relationship between anthropometric measurements and BP may be useful indicators for evaluating general health. In this study, we have pointed out that BMI is associated with SBP and DBP in young men. The correlation between BMI and DBP was stronger than BMI and SBP. Similar findings from previous studies support our findings.[7,9] However, the mean ages of our subjects were older (19.55±1.08 years) than in the previous study. The previous study showed the ability of BMI to discriminate hypertensive children.[9] Obesity affects hypertension through several

mechanisms. The first mechanism is via dysfunction of adipose tissue. The second mechanism is via the Renin-Angiotensin-Aldosterone system (RAAS). Then the third mechanism is via endothelial dysfunction.10

The correlation between MUAC with either SBP or DBP was not significant. This result was not in line with the previous study that proved the correlation between MUAC and blood pressure. [9,7,8]. The reason is that MUAC represents higher muscle mass in men and adiposity in women. A study from Hastuti 2018 found that MUAC was a secure predictor of SBP in girls, while in this study used men as subjects. [11]

In this study, we have proved the positive correlation between BMI and MUAC. Both BMI and MUAC were recommended to identify nutrition status and obesity. However, the strength of correlation was varied among the population.[10] BMI is the most frequent measurement to determine obesity in the large population but is unable to define central obesity, a risk factor for CVD. On the other hand, MUAC could be used as an alternative surveillance tool and screening of overweight in individuals aged 15–19 years.[12] Another study also stated that MUAC is a simple and effective tool to define central obesity, overweight, and obesity.[13]

CONCLUSION

We conclude that this study showed a positive correlation between BMI with systolic and diastolic pressure as well as the correlation between BMI and MUAC in young men subjects. Our findings support the prove many previous studies that BMI can be potentially used as a risk factor screening and prevention of hypertension. Several limitations should be considered in this study due to the cross-sectional design of this research, which is unable to show cause and effect relationship.

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