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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 see the correlation between BMI with blood pressure and MUAC, and MUAC with blood pressure in young men. This is a cross-sectional study which consisted of 38 male participants who met the criteria. Blood pressure, BMI, and MUAC was measured using standard procedure. 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 ($p\leq0.05$) with r=0.446 and r=0.537, respectively. Furthermore, there is a positive relationship between BMI and MUAC ($p\leq0.05$) with r=0.527. Contrarily, the MUAC and blood pressure shows no significant association. Thus, this study concluded a positive correlation between BMI with systolic and diastolic blood pressure as well as BMI and MUAC in young men subjects.

Keywords: Body mass Index; Cardiovascular disease; Diastolic Blood Pressure; Mid –upper arm circumference; Systolic blood pressure

ABSTRAK

Hipertensi dan obesitas merupakan faktor resiko dari penyakit kardiovaskular yang merupakam penyebab kematian utama. Pengukuran lingkar lengan atas (LiLA) dan indeks massa tubuh (IMT) merupakan pengukuran yang mudah dilakukan dapat menjadi parameter dini identifikasi dan pencegahan faktor resiko penyakit kardiovaskular. Banyak penelitian telah menunjukkan hubungan antara LiLA dan IMT dengan tekanan darah pada anak-anak dan dewasa, tetapi belum banyak ditel pada pria muda. Penelitian ini bertujuan untuk melihat hubungan antara LiLA dan IMT dengan tekanan darah pada pria muda. Penelitian ini merupakan penelitian observasional analisis dengan pendekatan cross-sectional. Sejumlah 38 responden yang memenuhi kriteria mengikuti penelitian sampai tuntas. Tekanan darah, IMT, dan LILa diukur menggunakan metode yang terstandar. Hasil didapatkan rerata IMT, LiLA, tekanan darah sistolik, dan diastolik berturut-turut $24{,}68\pm4{,}41$ kg/m^2, $30{,}23\pm5{,}45$ cm, $117{,}39\pm10{,}47$ mmHg, dan $75{,}57\pm8{,}44$ mmHg. Hasil uji korelasi Pearson antara IMT dan tekanan darah menunjukkan hasil bermakna ($p\leq0{,}05$) dengan r=0,446 dan r=0.537. Hubungan positif juga ditunjukkan oleh uji korelasi antara IMT dan LiLA ($p\leq0{,}05$) dengan r=0,527. Sebaliknya, hasil uji korelasi antara LiLA dan tekanan darah tidak bermakna secara statistik ($p\geq0{,}05$). Kesimpulan penelitian ini menunjukkan hubungan positif antara IMT dan tekanan darah, dan antara IMT dengan LiLa pada subyek pria muda.

Kata Kunci: Indeks massa tubuh; Hipertensi; Penyakit kardiovaskular; Tekanan darah diastolic; Tekanan darah sistolik

INTRODUCTION

Changes in people's unhealthy lifestyles have triggered a shift in the pattern of diseases which 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 a main risk factor for CVD, particularly in the 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 reduce 38% 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 measurements and 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 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.[789] 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

METHOD

Study Design

This study was an observational study 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 was 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.

Antropometric measurement

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 and weight (Kg) 0.1 Kg, respectively. The MUAC was measured using a tape at the middle of 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.

Blood Pressure measurement

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.

Statistic analytic

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 $p \leq 0.05$.

RESULTS

A total of 38 respondents were participated in this study. The description of participants characteristics are 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.

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/m2)	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

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/m2. 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 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 Image 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 significant statistically (p≥0.05).
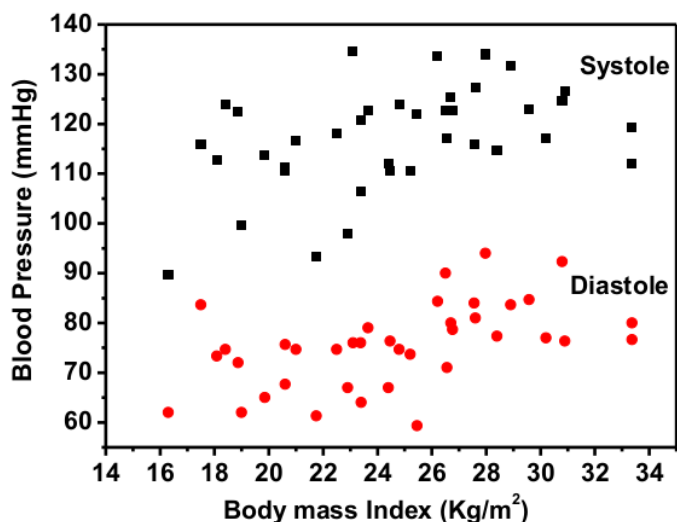
Image 1. Correlation between Body Mass Index with systolic blood pressure and Diastolic blood pressure shows positive relationships.

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≤0.05) and had a positive relationship (r=0.527). The Image 2 shows moderate associations between BMI and MUAC
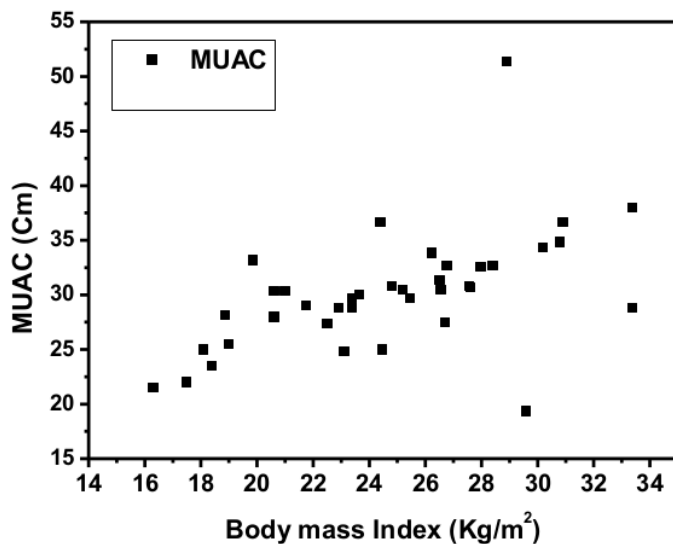
Image 1. The correlation between Mid-upper arm circumference (MUAC) and Body Mass Index (BMI) shows a positive relationship.

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DISCUSSION

In this study, we have proved the 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 National Center for Health Statistics stated that among adults aged 18–39 prevalence of hypertension was 33.2%.[3]

The relationship between anthropometric measurements and BP may be promising useful indicators to evaluate general health. In this study, we have pointed out that in young men, BMI is associated with SBP and DBP. The correlation between BMI and DBP was stronger than BMI and SBP. Similar findings from previous studies support our findings. [9][7]. However, the mean ages of our subjects were older (19.55±1.08 years) than 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 and 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 using men as subjects. [11]

We have proved the positive correlation between BMI and MUAC in this study. 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 unable to define central obesity which is a risk factor for CVD. In the other hand, MUAC could be used as an alternative surveillance's tool and screening of overweight in individual 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]

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 from previous study 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 a cross-sectional design of this research which unable to show cause and effect relationship and limited sample size.

ACKNOWLEDGEMENT

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