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Relationship between fat distribution ratio and blood pressure in obese adolescents

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Abstract

Background The incidence of obesity in big cities increases significantly. The association between obesity and increased risk of cardiovascular disease and hypertension in adults has been known but less information is available in adolescents. Similarly, the relationship between body-fat distribution and cardiovascular diseases in adolescents is less clear tha that in adults.

Objective This study aimed to determine the association between body fat distribution and increased blood pressure in obese adolescents in Bandung.

Methods This cross-sectional study was conducted from June to August 2006. Subjects were students aged 15-18 years at high schools in Bandung with body mass index (BMI) measured using CDC chart 2000 (> P95) and increased blood pressure (>P90) depended on age and gender according to National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents 2004. Waist-to-hip ratio (central fat), and subscapula skinfold-to-triceps skinfold ratio (peripheral fat) were used to measure fat distribution. Correlation between body fat distribution and blood pressure was analyzed using Pearson correlation statistical test.

Results Out of 3170 adolescents examined, 34 obese adolescent girls and 43 obese adolescent boys had increased blood pressure. Correlation between waist-to-hip ratio and systole blood pressure in boys showed by r=0.495; P=0.003 and girls showed r=0.494; P=0.001. Correlation between subscapula skinfold-to-triceps skinfold ratio in boys showed r=0.289; P=0.097 and girls showed by r=0.248; P=0.109.

Conclusion Central fat is moderately correlated with increased blood pressure in obese adolescents. **[Paediatr Indones 2008;48:274-7]**.

Keywords: *obesity, systole, central fat, peripheral fat*

Obesity in children is gradually becoming a public health problem in big cities and developed countries. The problem of obesity is associated with increased consumption of processed, fast food and high sodium diet that can increase central fat distribution associated with increased risk for cardiovascular disease and hypertension.[1-5] The prevalence of obesity among United States children aged 6-9 years in 1999-2000 is 16%. Data from Indonesian socioeconomic survey 1992 showed prevalence of overweight was 2.4%, but reached 6.3% in 1997.[6]

In adults, relationship between body-fat distribution and cardiovascular diseases is already known, but in adolescents. Recently, it has also been suggested that fat distribution may also be important in determining the risk of cardiovascular disease. Central fat, particularly in the abdomen, is associated with increased risk of cardiovascular diseases compared to the perifer fat.[7-12]

Some anthropometric measurements or computed tomography have been used to assess body-fat

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distribution. Accurate methods used to assess total body fat and body-fat distribution (computed tomography and magnetic resonance imaging) in humans are not suitable for use in large population studies because of the cost, irradiation exposure (i.e., computed tomography), and limited availability outside the research setting. In order to obtain a reasonable estimation of body-fat distribution in children, several anthropometric parameters have been proposed, such as subcutaneous skinfolds and body circumferences, which are easy to perform and have sufficient degree of accuracy.[13-17] This study was performed to determine the association between body fat distribution and increasing blood pressure in obese adolescents in Bandung.

Methods

This cross-sectional study was conducted from June to August 2006. Subjects were students at junior and senior high schools in SMP 2, SMP 5, SMP St. Aloysius, SMP BPI, SMA 5, SMA St. Aloysius, SMA BPI, and SMA BPK Penabur Bandung.

The inclusion criteria were age 15-18 years old, body mass index (BMI) which was measured using CDC chart 2000 (>p95) and increasing blood pressure (>p90) depends on age and gender according to National High Blood Pressure Education Program Working Gorup on High Blood Pressure in Children and Adolescents 2004.

Each child underwent a physical examination, body weight, height, BMI, and anthropometric measurements three times, followed by examination of blood pressure. Body weight was measured using platform beam balance scale, while height was measured with microtoise in standing position. Waist and hip circumference were measured with a nonstretchable tape. We measured the waist-to-hip ratio (central fat) and subscapula skinfold-to-tricep skinfold ratio (peripheral fat) to measure fat distribution, with Lange skin fold caliper.

Blood pressure was measured in the right arm with the subject sitting quietly 5 minutes according to the methodology described by Working Group on High Blood Pressure in Children and Adolescents 2004. The onset of the first Korotkoff phase was used to determine systolic blood pressure, and the onset of the fifth Korotkoff phase was used to determine diastolic blood pressure.

Correlation between body fat distribution and blood pressure was analyzed using Pearson correlation statistical test. Statistical analyses were performed with SPSS version 10.0 for Window 1999, SPSS mc, Chicago-Illionis, USA.

Results

This study included 1533 males and 1637 females. There were 111 (7.2%) obese males and 78 obese females (4.8%). After measuring the blood pressure, there were 43 obese adolescent boys and 34 girls who had increased blood pressure and enrolled in this study.

Subject characteristics

The subject characteristics differed substantially by sex are shown in **Table 1.**

Relationship between fat distribution and blood pressure

Relationship between fat distribution that represented with anthropometric variable and blood pressure measured by Pearson correlation was shown in

Table 1. Subject characteristics

Variable	Male (n = 43)		Female (n = 34)	
	Mean	Range	Mean	Range
Age	16 yrs	15–18 yrs	16 yrs	15 – 18 yrs
BMI (%)	97.78	95.28 – 99.83	96.81	95.07 – 99.38
Body Mass (kg)	89.06	62.8 – 134.8	77.17	61 – 100.1
Height (cm)	167.47	150 – 178.7	156.77	147.3 – 164

Table 2. Relationship between fat distribution and blood pressure in obese adolescent boys

Variable		Systolic	Diastolic
WHR	r	0.495**	0.066
	P	0.003	0.67
STR	r	0.289	0.405
	P	0.097	0.052

Note: r = Pearson coeficient correlation; P**: significant < 0.001; P*: significant < 0,05;STR: subscapular-to-triceps skinfold-thickness ratio; WHR: waist-to-hip ratio.

Table 3. Relationship between fat distribution and blood pressure in obese adolescent girls

Variable		Systolic	Diastolic
WHR	r	0.494**	0.114
STR	P	0.001	0.514
	r	0.248	0.117
	P	0.109	0.502

Note: r = Pearson coeficient correlation; P**: significant < 0,001; P*: significant < 0,05; STR: subscapular-to-triceps skinfold-thickness ratio; WHR: waist-to-hip ratio.

Table 2 for obese adolescent boys and **Table 3** for obese adolescent girls. **Tables 2** and **3** show that fat distribution with WHR had a moderate correlation with mean systolic in obese adolescent girls (r=0.494; P=0.001) and boys (r=0.494; P=0.001).

Discussion

This study showed the moderate correlation between central fat distribution and increased blood pressure in obese adolescents in Bandung. Central fat distribution is associated with increased blood pressure, especially systolic blood pressure in obese adolescent boys.

Obese children have increasing risk for metabolic complications like in obese adults.[18] In adults, relationship between obesity and increased blood pressure was already known, but the mechanism was not clear.[19] There is a hypothesis that genetic factor and visceral fat distribution (abdominal fat) correlates with hypertension.[20] Most central fats are visceral fat, so that thisese could explain the relationship between central fat accumulation and increased blood pressure.[18,21,22]

Fat accumulation in boys, particularly in the abdomen, has been associated with increased fat in the lower body segment, particularly the hips and thighs.[23] One hypothesis reported that testosteron at the spesific receptor resulted in the disappearance of adrenergic ß receptor. Adrenergic ß receptor wasis involved in lipolysis. The decrease of this receptor led to excessive accumulation of visceral fat. Accumulation of central visceral fat was significantly related to the increase of blood pressure.[18,23]

Measurement of WHR is most commonly used to determine fat distribution in adult and adolescent.[9] A ratio of more than 0.72 is considered abnormal, and the complication increases if the ratio is more than 0.78.[24] Our study showed that obese adolescents with WHR more than 0.84 has a risk of increasinged systole blood pressure.

We conclude that central fat has a moderate correlation with blood pressure in obese adolescents.

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