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# Relationship Between Blood Pressure and Lipid Profile on Obese Children

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**Abstract:** Background: Obesity in children is gradually becoming a serious public health problem in many countries worldwide. Fatness levels in obese children are indicative of increased risk for elevated blood pressure and lipid profile. Together with dyslipidemia and hypertension, obesity is associated with higher risk of cardiovascular morbidity later in life. Objective: To assess the result of the lipid profile on the obese children based on the blood pressure value. Methods: The cross sectional research was carried out from November 2012 to January 2013 in Makassar on the students of Junior High School of 13-15 years who met the obesity criteria. The research samples were divided into two groups i.e. the increasing blood pressure group percentile (P)  $\geq 90$  and the normal blood pressure group ( $< P90$ ) based on the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents 2004. Results: The total samples who fulfill the criterion are 80 students comprising 40 students whose blood pressure is  $\geq P90$  and 40 students whose blood pressure is  $< P90$ . The significant statistic analyses found that the frequency of high total cholesterol incident ( $\geq 200$  mg/dl) is more on the blood pressure group of  $\geq P90$  compared to  $< P90$  with value of  $p = 0.019$ , OR 3.12 (95%CI 1.18-8.20). Conclusions: Based on the statistical analyses results, it can be concluded that frequency of the high total cholesterol incident is more on the increasing blood pressure group ( $\geq P90$ ) compared with the normal blood pressure group ( $< P90$ ).

**Keywords:** Children, Obesity, Blood Pressure, Lipid Profile

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## 1. Introduction

Obesity is a pathological condition, marked by the accumulation of fat in the adipose tissue to an extent that could harm the health. Obesity in children had started to become a worldwide health problem, indeed WHO stated obesity as a global epidemic need to be addressed immediately.<sup>1</sup> Its prevalence had alarmingly increased throughout the world, both in developed and in developing country, thus demanding attention because obesity in children more likely to developed into obesity in adulthood which related to increased mortality and morbidity.<sup>2,3,4</sup>

Obesity occurred when energy intake was higher than energy expenditure.<sup>5</sup> Overweight would lead to health problems, increased the likelihood to have co morbid diseases, decreased the life expectancy and disadvantage in terms of lost of productivity in the productive age.<sup>2,6</sup> The percentage of body fat in obese children and adolescent carried the risk for high blood pressure, atherogenic lipid

profile alteration which would promote atherosclerosis in obese children, thus increased the risk for early coronary heart disease and other cardiovascular diseases.<sup>7,8</sup> Therefore, it is important to perform a study about the association between blood pressure and lipid profile in obese children.

In 1988-1994, based on survey by the National Health and Nutritional Status in the United States (NHANES III), approximately 30% obese teenage had metabolic syndrome, a syndrome that was a set of clinical symptoms consisting of insulin resistance, glucose tolerance and abnormal lipid profile, also high blood pressure associated with obesity.<sup>9</sup> Screening for metabolic markers in clinical setting is important to do, concerning the high prevalence of metabolic syndrome in obese children. Dyslipidemia and increased in blood pressure were two clinical parameters could be detected earlier in obese children and adolescent, therefore can help slowing down and preventing chronic complication

from occurring.<sup>3, 9, 10</sup> Lipid profile examination, including total cholesterol, LDL (*low density lipoprotein*), HDL (*high density lipoprotein*) and triglyceride, had a high predictor for the incidence of cardiovascular in adulthood because several studies have shown that lipid profile abnormalities in obese children tend to persist until adulthood.<sup>11, 12</sup> Therefore, the American Heart Association had recommended the evaluation of lipid profile to be performed on all overweight and obese children.<sup>9, 13</sup>

Routine blood pressure measurement can be used to detect hypertension as early as possible especially on obese children known to have higher risk for hypertension compared to children with normal body weight.<sup>14</sup> A recommendation from the fourth report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents to perform lipid profile examination on every overweight and obese children with blood pressure on 90<sup>th</sup> percentile to assess the co morbidity. Dyslipidemia prevalence on obese children and its association with high blood pressure remain unknown.<sup>9</sup> Therefore it is necessary to conduct an investigation about the association between blood pressure and lipid profile in obese children. Detection and control of these risk factors were the reasoning for preventing atherogenic process within the last two decades.

Studies on blood pressure and lipid profile in obese children are still limited, especially in South Sulawesi. Therefore, this study is conducted to evaluate lipid profile in obese children based on the blood pressure.

## 2. Material and Methods

This study was conducted in several private junior high school in Makassar, and was a cross sectional study to evaluate the lipid profile with blood pressure in obese children. Obese assessment and blood pressure measurement were done simultaneously with blood lipid examination.

Population was private junior high school student age 13-15 years in Makassar with middle to upper socioeconomic status according to criteria set by Department of Education Makassar found to have high probability of obese. Samples were collected using cluster random sampling method. Subject was junior high school student's age 13-15 years who met the obese criteria such as BMI (body mass index)  $\geq$ P95 based on CDC chart 2000, and were willing to participate in the study (granted parental consent). This study was approved by the Ethics and Industry Research Committee of the hospital.

Then blood pressure were measured and the results were grouped into two groups; obese group with blood pressure  $\geq$ P90 and blood pressure  $<$ P90. Sample size estimation was minimum 35 subjects each group.

All samples who met the inclusion criteria were recorded for their age, sex, weight, height, BMI and blood pressure. Body weight was measured with standing scale, which had been calibrated with 0.1 kg precision. Body height was measured using microtoise with 0.1 cm precision. Nutritional status was determined based on BMI calculation from Weight

over Height square ( $\text{kg}/\text{m}^2$ ). Blood pressure measurement was performed using mercury sphygmomanometer according to standard method by National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents years 2004. Data sample recording were continued with blood lipid examination, including total cholesterol, HDL, LDL, triglyceride, LDL-HDL ratio, and dyslipidemia frequency.

Data analyses were performed using Chi-square test to assess the association of abnormal lipid profile frequency and student *t* test to evaluate the association of lipid profile on blood pressure group. The analyses is not significant, when  $p > 0.05$ , significant if  $p \leq 0.05$ , and very significant if  $p < 0.01$ .

## 3. Results

Table 1. showed the characteristics of sample. Total of 80 obese junior high student were obtained, consist of 40 obese students with blood pressure  $\geq$ P90 and 40 obese students with blood pressure  $<$ P90. Of total sample, there were 56 students were male (70%) and 24 (30%) female.

Table 1. Study Characteristics.

No.	Characteristics	Total (n: 80)
1.	Sex	
	Male : Female (%)	56 : 24 (70 : 30)
2.	Age (years)	13.8
	Range	13.12 – 15.32
3.	Degree of Obesity	
	Obesity: Superobese (%)	31 : 49 (38.8 : 61.3)
4.	Body Weight (kg)	72.5 (11.25)
	Range	46.9 - 105
5.	Body Height (m)	1.56 (7.49)
	Range	1.34 – 1.76
6.	Body Mass Index ( $\text{kg}/\text{m}^2$ )	29.48 (3.21)
	Range	25.1 – 40.5
7.	Total Cholesterol (mg/dl)	189.94 (35.87)
	Range	112 – 297
8.	Triglyceride (mg/dl)	127.44 (55.64)
	Range	49 – 312
9.	HDL Cholesterol (mg/dl)	48.77 (9.68)
	Range	28 – 74
10.	LDL Cholesterol (mg/dl)	118.54 (31.84)
	Range	53 – 203
11.	LDL : HDL Ratio	2.53 (0.873)
	Range	1.3 – 5.1

Table 2. showed the association of abnormal lipid profile frequency with blood pressure. From the group of patient with blood pressure  $\geq$ P90 were found that the frequency of children with high total cholesterol as much as 67.9% compared to group with blood pressure  $<$ P90 was 32.1%. Statistical analyses showed a significant difference between frequency of high total cholesterol incidence ( $\geq$ 200 mg/dl) on blood pressure group with  $p = 0.019$  ( $p \leq 0.05$ ), OR: 3.12 (95% CI 1.18-8.20). While statistical analyses relationship of high triglyceride incidence ( $\geq$ 150 mg/dl), low HDL ( $<$ 40 mg/dl), high LDL ( $>$ 129 mg/dl), and high LDL – HDL ratio ( $\geq$ 3) on

blood pressure had no significant difference, with  $p > 0.05$ .

**Table 2.** Relationship between abnormal lipid profile frequency and blood pressure group.

No.	Lipid Profile Variable	Blood Pressure		p
		Percentile <90	Percentile ≥90	
1.	Total Cholesterol (mg/dl)			0.019
	≥200	9 (32.1%)	19 (67.9%)	
2.	Triglyceride (mg/dl)			0.317
	≥150	9 (40.9%)	13 (59.1%)	
3.	HDL Cholesterol (mg/dl)			0.556
	<40	8 (57.1%)	6 (42.9%)	
4.	LDL Cholesterol (mg/dl)			0.152
	>129	10 (38.5%)	16 (61.5%)	
5.	LDL : HDL Ratio			0.446
	≥3	9 (42.9%)	12 (57.1%)	
	<3	31 (52.5%)	28 (47.5%)	

Chi-square  $X^2$

Table 3 showed the relationship between the incidence frequencies of dyslipidemia on blood pressure. From blood pressure of group ≥P90 were found 50% children with dyslipidemia compared to group of blood pressure <P90

which were also 50%. Statistical analyses showed there were no significant difference between the frequency of dyslipidemia incidence between the two group, with  $p = 1.000$  ( $p > 0.05$ ).

**Table 3.** Relationship between dyslipidemia frequency and blood pressure group.

Dyslipidemia	Blood Pressure		Total
	Percentile <90	Percentile ≥90	
Dyslipidemia	24 (50%)	24 (50%)	48 (100%)
Not Dyslipidemia	16 (50%)	16 (50%)	32 (100%)
Total	40 (50%)	40 (50%)	80 (100%)

Chi-square  $X^2 = 0.000$   $df = 1$   $p = 1.000$  ( $p > 0.05$ )

Table 4 showed the relationship between lipid profile and blood pressure. Statistical analyses showed that there were no significant difference between the total cholesterol levels,

triglyceride, and LDL to blood pressure with  $p = 0.000$ ,  $p = 0.024$ , and  $p = 0.027$  ( $p \leq 0.05$ ) respectively.

**Table 4.** Relationship between lipid profile level and blood pressure group.

Lipid Profile	Blood Pressure Group (n = 80)		p
	Percentile <90 (n = 40)	Percentile ≥90 (n = 40)	
Total Cholesterol (mg/dl)			0.000
Mean (SD)	176.05 (30.494)	203.83 (35.781)	
Median	176.00	194.50	
Range	112-247	146-297	
Triglyceride (mg/dl)			0.024
Mean (SD)	113.45 (36.764)	141.43 (67.215)	
Median	106.00	125.50	
Range	49-193	53-312	
HDL Cholesterol (mg/dl)			0.492
Mean (SD)	48.03 (9.062)	49.53 (10.330)	
Median	46.00	49.00	
Range	34-74	28-74	
LDL Cholesterol (mg/dl)			0.027
Mean (SD)	110.73 (26.818)	126.35 (34.766)	
Median	110.00	118.50	
Range	53-182	67-203	
LDL : HDL Ratio			0.111
Mean (SD)	2.372 (0.694)	2.683 (1.0057)	
Median	2.328	2.600	
Range	1.4-3.9	1.3-5.1	

t test

## 4. Discussion

This is a cross sectional study to evaluate lipid profile in obese children based on their blood pressure; obese group with blood pressure  $\geq$ P90 and obese group with blood pressure  $<$ P90. Total of 80 obese children were obtained, 40 of them (50%) were obese children with blood pressure  $\geq$ P90 and 40 (50%) obese children with blood pressure  $<$ P90. Analyses were performed between lipid profile, such as total cholesterol, triglyceride, HDL, and LDL in view of each abnormal lipid profile frequency and its levels to blood pressure in obese children. Association analyses between LDL-HDL ratio group frequency, and also dyslipidemia frequency on blood pressure group.

Association between sex on blood pressure group in obese children showed no significant difference with  $p = 1.000$ , which mean that sex had no influence on blood pressure in obese children. This was similar to a study by Akhtar *et al.* in Pakistan, which analyze the relationship between obese to blood pressure and lipid parameter in 200 obese sample.<sup>15</sup>

In statistical analyses on the frequency of abnormal lipid profile to blood pressure were found that only high cholesterol had a significant difference on blood pressure group with  $p = 0.019$ , OR = 3.12 (95% CI 1.18-8.20). This means that obese children whose blood pressure  $\geq$ P90 had 3.12 times bigger risk to experienced increased of total cholesterol ( $\geq$ 200 mg/dl) compared to obese children whose blood pressure  $<$ P90. This is because obese children with increased blood pressure suffered from more severe insulin resistance due to a higher free fatty acid flux compared to obese children with normal tension, therefore, this insulin resistance will cause alteration in lipid profile. This result was similar with a study by Saely *et al.* in Swiss which reported a significant relationship between total cholesterol, blood pressure and BMI.<sup>16</sup>

From this study, statistical analyses showed no significant difference between dyslipidemia incidence on blood pressure in obese children, with  $p = 1.000$ . This can be explained that lipid profile abnormality in obese children were not only caused by insulin resistance and process in portal circulation pathway due to an increased in free fatty acid level in obese children, but also influenced by other pathways such as external factors, including physical activity, stress and diet, along with internal factors like race, hormonal, and genetic (family history of dyslipidemia). In short, increased in blood pressure and lipid profile abnormality in obese children not always arose from obesity because there are other risk factors.

The association between lipid profile levels on blood pressure in obese children in this study observed that the total cholesterol, triglyceride and LDL had a significant relationship with the two blood pressure group with  $p \leq 0.05$ . Although from the analyses result frequency of high triglyceride and high LDL showed no significant difference on blood pressure. This means that in obese children whose blood pressure  $\geq$ P90 increased triglyceride and LDL were found and it was just the matter of time to progress to hyper

triglyceride and high LDL levels. The result was same to study by Akuyam *et al.* in Nigeria that reported a significant relation between total cholesterol on blood pressure.<sup>17</sup> Similar results also observed by Boyd *et al.* that there were significant association between triglyceride levels on blood pressure of children and adolescent in USA.<sup>9</sup> Several epidemiological studies also reported that LDL was a main atherogenic factor that increased the risk of cardiovascular disease. A study by Sharett *et al.* also noted that the increased in LDL levels also increased the risk of cardiovascular disease 3 times folds.<sup>18</sup> LDL-HDL ratio was used as predictive value for atherosclerosis and coronary heart disease risk. In this study, analyses of LDL-HDL ratio on blood pressure in obese children had no statistic significant, either in terms of frequency of high LDL-HDL ratio ( $\geq 3$ ) or the mean value on blood pressure, with  $p = 0.446$  and  $p = 0.111$ , respectively.

We realizes that there are many limitation in this study, one of it is the analyses on race and genetic were not performed, although they also could influence blood pressure and lipid profile. Also, we did not interfere daily intake of the patients before the lipid profile examination, because in this study sample were obtained from children who were not in fasting condition, so the results were unlike other studies that use fasting blood sample. Other limitation is this was a cross sectional study, therefore we could only see a onetime comparison between the two group, and it didn't show a clear association effect. The results of this study were hoped to be able to give a feedback to the school in order to promote preventive efforts in increased blood pressure and lipid profile abnormality.

We conclude that there were significant relationship between blood pressure and total cholesterol in obese children in terms of frequency of high total cholesterol incidence ( $\geq 200$  mg/dl) which mostly found in group with blood pressure  $\geq$ P90 compared to group with blood pressure  $<$ P90, OR = 3.12 (95% CI 1.18-8.20). It is recommended to measure blood pressure and examine lipid profile in all obese children as a prevention and protection against chronic complication as well as early intervention in the later life.

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