Curr Pediatr Res 2018; 22 (1): 77-81

ISSN 0971-9032
www.currentpediatrics.com

Association between body fat percentage and lipid profile in children with obesity.

Aidah Juliaty, Yuniaty Arief, Johan Setyawan Lisal, Dasril Daud

Department of Pediatrics, Faculty of Medicine, Hasanuddin University, Makassar, South Sulawesi, Indonesia.

Abstract

Background: A high body fat percentage (BFP) in children with obesity which is associated with higher risk of cardiovascular disease and metabolic syndrome later in life, leads us to study the associations between BFP and lipid profile in obese children to prevent the disease. This study aimed to investigate the associations between BFP and lipid profile in obese children.

Methods: A cross-sectional study had been conducted from June to July 2014 in Makassar on students of Junior High School, aged 13-15 years who met the criteria for obesity. The study samples were divided into two groups; the high BFP group (≥ P85) and the normal BFP group (<P85).

Results: Total of samples was 100 students, consisted of 50 students in high BFP group and 50 students in normal BFP group. The results of bivariate analyses revealed that there were 4 variables of lipid profile and dyslipidemia which frequencies were higher in the the high BFP group than in normal BFP group; total cholesterol (p=0.000), triglyceride (p=0.000, OR 16.0 with 95% CI (3.49-73.41)), LDL-C (p=0.000, OR 57.5 with 95% CI (7.36-449.7)), LDL-C/HDL-C ratio (p=0.000, OR 7.534 with 95% CI (3.08–18.44)), and dyslipidemia (p=0.000, OR 84.33 with 95% CI (22.28-319.17)).

Conclusion: The frequency of high cholesterol, triglyceride, LDL-C, C-LDL/C-HDL ratio and dyslipidemia incidence were higher in the body the high BFP group than in the normal BFP group.

Keywords: Body fat percentage, Lipid profile, Obesity, Children.

Accepted March 21, 2018

Introduction

Obesity is a pathological condition characterized by the accumulation of excess body fat tissue is necessary for the functioning of the body [1,2]. According to Supariasa et al. [3] there are many people who thought that a fat child is healthy. Obesity is associated with the significant health problems in children and predisposes to obesity in adulthood, as well as the incidence of metabolic and cardiovascular co-morbidity and mortality [4]. Based on BPPKKK-RI the average prevalence of obesity in adolescents aged 13-15 years is 10.8%, the highest were in Papua and the lowest were in East Nusa Tenggara [5]. There are 13 provinces with a higher prevalence of obesity than the national average. It is the same with WHO estimation; 10% in children aged 5-17 years. Although BMI is the most frequently used method to assess the level of obesity, BMI does not differentiate between body lean mass and body fat mass; that is, a person can have a high BMI but still have low fat mass and viscera. Several methods are available for evaluating percentage of body fat such as dual-energy X-ray absorptiometry (DXA), multi-frequency Bioelectrical Impedance and air displacement plethysmography. Nevertheless, that methods high cost and low availability have made it difficult to use in large population studies. This factor limit the possible screening of dyslipidemia in high risk population especially in developing countries such as Indonesia.

According to thermodynamic laws, obesity occurs due to energy intake and expenditure imbalance which can cause energy excess that later stored in the form of fat tissue [1]. The amount of adipose tissue in obesity causes the increased of lipolysis and free fatty acid turnover that led to a pathological disorder of non-adipose tissue organs such as the liver, muscle, pancreas, and blood vessels [6-8]. The increased flow of free fatty acids directly from the portal system to the liver leads to increasing of Very

Low Density Lipoprotein *(VLDL)* production that is rich in triglycerides, decreased of insulin sensitivity, increased of gluconeogenesis, and release of glucose by the liver. This will lead to impaired glucose tolerance and diabetes. In addition, there is increased activity of cholesterol ester transfer protein (CETP) and a decrease of lipoprotein lipase (LPL) which ultimately led to increased levels of low-density lipoprotein (LDL) cholesterol and decreased the high-density lipoprotein (HDL) cholesterol in the circulation. Therefore, the study is important to be done on the relationship of body fat percentage and lipid profile in children with obesity. Childhood obesity is associated with insulin resistance, abnormal glucose metabolism, increased blood pressure, dyslipidemia, inflammatory and vascular functions are depressed which all are components of metabolic syndrome. Many studies have shown a correlation between high serum lipid levels and the incidence of coronary heart disease and atherosclerosis in human so, it is necessary to conduct such this study in order to take a preventive action against the risk of dyslipidemia and cardiovascular disease by monitoring the BFP and lipid profile levels in children with obesity. This study aimed to evaluate the lipid profile in children with obesity based on BFP.

Materials and Methods

Study Design and Population

This study was a cross sectional study of blood lipid levels in children with obesity based on the percentage of body fat. This study conducted in several private junior high schools in Makassar, such as Frater's, Athirah's, and Nusantara's from June to July 2014. All the eligible populations were the students of private schools with middle to high socio-economic status according to the criteria by the Education Department of Makassar with the high of obese probability. Samples are all the eligible population met the inclusion and exclusion criteria. The inclusion criteria are the patients of age 13-15 years and an obese, while the exclusion criteria were patients with obesity caused by a genetic abnormality/ chromosomal or syndrome (endogenous obesity) based on the history examination, suffering nephritic syndrome, diabetes mellitus, or hypothyroid, and to receive long-term corticosteroid treatment, chemotherapy or other drugs that affect weight.

Anthropometric Measurements

Anthropometric measures comprised height, weight and waist circumference. Height was measured to the nearest 0.1 centimeter using microtoise, obtained without shoes, back straight with buttocks and shoulders touching a wall and head forward. Weight was measured, to the nearest 0.1 kilogram using digital floor scale. The child was weighed in light clothes (no shoes or heavy outer garments). Body mass index was calculated by dividing weight by height (kg/m^2). Obesity was defined as body mass index (BMI) higher than 95th percentile for age and gender. Skin fold thickness to the nearest 1 mm was obtained at four sites (biceps, triceps, sub scapular, and suprailiac) on the subject's right side using a Lange caliper (Beta Technology, Inc., Cambridge, MD), and prediction equations published by Durnin and Womersley used to estimate percent body fat from that measured.

Then, all participants divided into two groups. The first group is the children whose BFP ≥ 85 and the second group is children whose BFP<P85. There are 140 students, 55 students of Frater's, 35 students of Nusantara's and 50 students of Athirah's. Unfortunately, there are 30 students who did not meet the inclusion criteria (16 of them are overweight, 4 student with a well nutritional, and 13 students are age <13 years) and 10 students refused to make a further examination. Therefore, there were only 100 students as samples in this study.

Laboratory Measurements

Blood collection was obtained by venipuncture after overnight fasting (8-11 h) from both the study and control groups. Blood analysis for total cholesterol, Triglyceride, LDL-C, HDL -C level were measured with Chemilimenescence method, COBAS Integra 400 plus. Dyslipidemia was defined in accordance with NCEP ATP III, 2002 criteria. Participants were considered to have dyslipidemia if they showed one or more of the following (1) high total cholesterol (≥ 200 mg/dl); (2) hypertrigliceridemia (≥ 150 mg/dl); (3) high LDL-C (>129 mg/dl); (4) low HDL-C (<40 mg/dl).

Data analyses

Statistical analyses were performed using IBM SPSS version 21.0 software. Mean and standard deviation were used in the descriptive analysis of variables. The Kolmogorv-Smirnov was used to verify data normality. Differences in the averages of variables between study and control group were analyzed by the Mann Whitney test. Fischer's exact test was used for categorical variables. $P<0.05$ was accepted as statistically significant.

Ethics Statement

This study has been approved by the Ethic and Research Committee of the Hospital and Hasanuddin University. Written informed consent was obtained from the patient's parents or legal guardian following full and detail explanation regarding the study's protocol.

Results

Table 1 shows the characteristics of the study samples. Of all the available sample (100), there were 50 children who belong to the BFP ≥ P85 group and 50 children in the BFP<P85 group which consist of 64 male (64%) and 36 female (36%). The mean age of the study sample was 13.75 years (range 13.04 to 14.98 years). The body mass index of patients gained an average 29.29 kg/m^2 (range 25. 81-40.51 kg/m^2).

Table 1. Sample characteristics

No.	Sample characteristics	Total (N:100)
1	Sex	
	Male: Female (%)	64:36 (64:36)
2	Age (years)	
	Range	13.04–14.98
	Mean	13.75
3	Body Mass Index (kg/m^2)	
	Range	25.81–40.51
	Mean (SD*)	29.29 (3.01)
4	Lipid Profile level (mg/dl)	
	Total Cholesterol	
	Range	112–297
	Mean (SD*)	185.63 (35.51)
	Triglyceride	
	Range	49 – 312
	Mean (SD*)	119.01 (53.79)
	HDL cholesterol	
	Range	28–74
	Mean (SD*)	49.18 (9.60)
	LDL cholesterol	
	Range	53–203
	Mean (SD*)	114.87 (31.40)
5	LDL cholesterol ratio:HDL cholesterol	
	Range	0.9–5.1
	Mean (SD*)	2.43 (0.858)

Male group consisted of 31 students (48%) with BFP <P85 and 33 students (51.6%) with BFP ≥ P85, while female group consisted of 19 students (52.8%) with BFP <P85 and 17 students (47.2%) with BFP ≥ P85. Statistical analysis on Table 2 showed that there was no significant difference between sex category and body fat percentage in children with obesity, p=0.677 (p>0.05)

Table 3 shows the frequency of children with high triglyceride levels in the BFP ≥ P85 group is 40% compared while in the BFP<P85 group is 4%. Statistical analysis showed a highly significant difference between the high triglyceride group with group based on BFP in children, *p=0.000* (p<0.01). Crude odds ratio (COR)=16.0 with 95% CI (3.49 to 73.41), which means that children with BFP ≥ P85 16 times riskier to have high triglyceride levels than children with BFP<P85.

The frequency of children with high levels of HDL cholesterol is lower in the BFP ≥ P85 group with 22% than in the BFP<P852 group with 8%. Statistical analysis showed a significant difference between low HDL cholesterol group to both groups, p=0.05 (p ≤ 0.05). However, the value of crude odds ratios (COR)=3.24 with 95% CI (0.96 to 11.0), which means the odds ratio includes the value 1, indicates that the BFP ≥ 85 is not a risk factor for low HDL cholesterol levels. The frequency of children with high LDL cholesterol levels in BFP ≥ P85

Table 2. Sex relations against the percentage of body fat in obese children

Sex	Percentage of Body Fat		Total
	<P85	<P85	
Male	31 (48.4%)	33 (51.6%)	64 (100%)
Female	19 (52.8%)	17 (47.2%)	36 (100%)
Total	50 (50%)	50 (50%)	100 (100%)

Chi-square X^2=0.174; df=1; *p*=0.677; (*p*>0.05)

group is 54%, while BFP <P85 group is 2%. Statistical analysis showed a highly significant difference between high LDL cholesterol group with the percentage of body fat in children with obesity, p=0.000, crude odds ratio (COR) value=57.5 with 95% CI (7.36 to 449.7). Children with a BFP ≥ P85 are 57.5 times riskier to have high cholesterol levels of LDL than children with a body fat percentage <P85.

The frequency of children with value ratio of cholesterol LDL and HDL are higher in BFP ≥ P85 group which is 68% than in BFP<P85 group with 22%. Statistical analysis showed a highly significant difference between the groups and the ratio of LDL cholesterol to HDL cholesterol high body fat percentage in a group of children with obesity, *p=0.000* and Crude odds ratio (COR)=7.534 with 95% CI (3.08 to 18.44), means that children with BFP ≥ P85 are 7.534 times riskier to have a high LDL ratio cholesterol and have a higher HDL cholesterol than children with BFP<P85. The frequency of children in BFP ≥ P85 group who had dyslipidemia is 92% while in the BFP<P85 group is 12%. Statistical analysis showed a highly significant difference between the dyslipidemia group and BFP in children with obesity group, p=0.000 (p<0.01). Crude odds ratio (COR)=84.33 with 95% CI (22.28 to 319.17), which means that children with BFP ≥ P85 are 84.33 times riskier for experiencing dyslipidemia than children with BFP<P85.

Discussion

This study used a cross-sectional design to assess the results of lipid profile in children with obesity based on the value of BFP and gained 50 students for both of ≥ P85 and <P85. The lipid profile variables and dyslipidemia were analyzed for the percentage of body fat in the group of children with obesity, it is seen that the frequency of occurrence of high total cholesterol, high triglycerides, high LDL cholesterol, ratio of LDL cholesterol and higher HDL cholesterol, as well as dyslipidemia significantly different in BFP of children with obesity. Based on research by Lamb et al. [9] approximately 10% (60.7% (SE) samples of high total cholesterol, low of its HDL 7.060.4% cholesterol, high triglycerides and 9.761.0% 7.660.7% of its LDL high cholesterol. Prevalence the cholesterol levels of the total of the cholesterol, HDL cholesterol, triglycerides, LDL cholesterol harmful in

Table 3. *Relationship of lipid profile against the percentage of body fat in obese children*

Lipid profile	Body fat percentage		Total		OR
	<P85	≥ P85		P value	95% CI
Total Cholesterol (mg/dl)					
≥ 200	29 (58.0%)	0 (0%)	29 (29%)	p=0.000	
<200	21 (42.0%)	50 (100%)	71 (71%)	p<0.01	
Triglyceride (mg/dl)					
≥ 150	20 (40%)	2 (4%)	22 (22%)	p=0.000	OR: 16.0
<150	30 (60%)	48 (96%)	78 (78%)	p<0.01	95% CI (3.49-73.41)
HDL Cholesterol (mg/dl)					
<40	11 (22%)	4 (8%)	15 (15%)	p=0.05	OR: 3.24
≥ 40	39 (78%)	46 (92%)	85 (85%)	p ≤ 0.05	95% CI (0.96-11.0)
LDL Cholesterol (mg/dl)					
>129	27 (54%)	1 (2%)	28 (28%)	p=0.000	OR: 57.5
≤ 129	23 (46%)	49 (98%)	72(72%)	p < 0.01	95% CI (7.36-449.7)
Cholesterol Ratio LDL : HDL					
≥ 2.5	34 (68%)	11 (22%)	45 (45%)	p=0.000	OR: 7.534
<2.5	16 (32%)	39 (78%)	55 (55%)	p<0.01	95% CI (3.08-18.44)
Dyslipidemia					
Dyslipidemia	46 (92%)	6 (12%)	52 (52%)	*p*=0.000	OR: 84.33
≠ Dyslipidemia	4 (8%)	44 (88%)	48 (48%)	*p*<0.01	95% CI (22.28-319.17)

adolescents with high adiposity was significantly greater than adolescents without high adiposity. The standard measurement of BFP is still limited. A research conducted by Khadgawat et al. [10] concluded that the BFP 85 percentile cut of point to declare the child not healthy. The limits of BFP is associated with cardiovascular disease risk factors and metabolic syndrome in a study conducted by Going et al. [11] in accordance with the percentage of body fat percentile 85 distribution was used as the cutoff point to declare the BFP of children with unhealthy on the curve by Khadgawat et al. [10]. It is also relevant with the study by Williams et al. [12] involving 3320 children and adolescents aged 5-18 years in the United States which reported that children and adolescent males with BFP ≥ 25.0 have a risk of 2.8% (95% CI=1.7-4.8) to 7.0 (95% CI=3.6-13.6) increase in systolic blood pressure, diastolic blood pressure, LDL cholesterol and the ratio of HDL cholesterol, and the ratio of VLDL cholesterol +LDL cholesterol and HDL cholesterol than the male children and teenage with BFP <10%. Research by Steinberg et al. [13] also reported a negative association between HDL cholesterol levels and BFP is a positive relationship between the percentages of body fat triglycerides.

Based on these results, the frequency of high incidence of total cholesterol, high triglycerides, low HDL cholesterol, high LDL cholesterol, and the ratio of LDL cholesterol and HDL cholesterol higher than the frequency of occurrence of total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol, and the ratio of LDL cholesterol and cholesterol normal HDL in children with obesity whose BFP ≥P85 is almost equal. This can be caused by changes in the lipid profile as a result of an increase of BFP is a biological process that takes place over several stages and takes time to occur, which can be different for each individual.

The absence of typical symptoms due to dyslipidemia makes children with obesity who have a particularly high BFP may be advisable to check the levels of total cholesterol, triglycerides, LDL cholesterol and HDL cholesterol.

The strength of this study is the chosen school has run smoothly up the student health room both teachers, parents, and the student give attention to health, so is expected to provide feedback to the school and parents to improve preventive efforts against obesity and abnormal lipid profile in this research. The limit of percentile curves and BFP regression formula used is regional, the cut off point for the determination of changes in lipid profile wearing adult standards, and not tested on other factors that might also influence the changes in the lipid profile and BFP as a factor racial, genetic, pubertal status, and diet.

The frequency of occurrence of high cholesterol, high triglycerides, high LDL cholesterol, ratio of LDL cholesterol and higher HDL cholesterol, and dyslipidemia in children with obesity are higher in children with BFP ≥ P85 than in children with BFP<P85. Based on this study it can be suggested the need for further monitoring of children with BFP ≥ P85 can be done for prevention and early intervention on the risk of cardiovascular disease later in life. It need a further research using cohort study design to assess changes in lipid profile in obese children with high BFP lipid profile when this cross-sectional study was within normal limits. A further research involving other factors that may also affect the incidence of dyslipidemia such factors as race, genetics, pubertal status, and diet is also necessary to do.

References

1. Sjarif DR. Obesity in children and problems. In: Sjarif DR, Lestari ED, Mexitalia M, Nasar S. Pediatric Nutrition and Metabolic Disease. Jakarta: IDAI. 2011.
2. Subardja D, Cahyono HA, Moelyo AG. Obesity in Children. In: Coal JR, Tridjaya B, Pulungan AB. Textbook on endocrinology of children: UKK Endocrinology. 1st Ed. Jakarta: IDAI Publishing Agency, 2010.
3. Supariasa IDN, Bakri B, Fajar I. In. Assessment of nutritional status. Jakarta: EGC. 2002.
4. Weiss R, Kaufmann F. Metabolic complications of childhood obesity. Diabetes Care 2008; 31: S310-316.
5. Agency for Health Research and Development Ministry of Health Republic of Indonesia. Basic Health Research. Jakarta: Ministry of Health Republic of Indonesia. 2013.
6. Jensen MD. Adipose tissue as an endocrine organ: implication of its distribution on free fatty acid metabolism. Eur Heart J 2006; 8: B13-19.
7. Singh AK, Singh SK, Singh N, et al. Obesity and dyslipidemia. Int J Biol Med Res 2011; 2: 824-828.
8. Slyper AH. Childhood obesity, adipose tissue distribution, and the pediatric practitioner. Pediatrics 1998; 102: 1-9.
9. Lamb MM, Ogden CL, Carrol MD, et al. Association of body fat percentage with lipid concentrations in children and adolescent: United States, 1999-2004. Am J Clin Nutr 2011; 94: 877-883
10. Khadgawat R, Marwaha RK, Tandon N, et al. Reference intervals of percentage body fat in apparently healthy north-indian school children and adolescent. Indian Pediatr 2013; 50: 859-866.
11. Going SB, Lohman TG, Cussler EC, et al. Percent body fat and chronic disease risk factors in US children and youth. Am J Prev Med 2011; 41: S77-86.
12. Williams DP, Going SB, Lohman TG, et al. Body fatness and risk for elevated blood pressure, total cholesterol, and serum lipoprotein ratios in children and adolescent. Am J Public Health 1992; 82: 363.
13. Steinberg HO, Tarshoby M, Monestel R, et al. Elevated circulating free fatty acid levels impair endothelium-dependent vasodilation. J Clin Invest 2005; 100:1230-1239.

Correspondence to:

Aidah Juliaty,
Department of Pediatrics,
Faculty of Medicine,
Hasanuddin University.
Jalan Perintis Kemerdekaan Km. 11 Tamalanrea,
Makassar, 90245,
Indonesia.
Tel: 62411 584461;
Fax: 62411 590629;
E-mail: aidah_juliaty@yahoo.com