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Research Article

Relationship between Lipid Profile and Left Ventricular Mass in Obese Adolescents

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Abstract: Childhood obesity is associated with an increased risk of death due to cardiomyopathy and atherosclerosis in adulthood. Hyperlipidemia, hypertension, obesity, diabetes mellitus, smoking, lack of exercise, and family history of cardiovascular disease is closely associated with cardiovascular process. Dyslipidemia is one of the complications of obesity. It is known that an increase of LDL, decreased HDL is associated with atherosclerosis, which indirectly leads to an increase in left ventricular mass.Examination by M-mode echocardiography is needed to obtain a picture of the left ventricular mass and left ventricular function in a child with obesity. Echocardiography can be a reliable andnon-invasive indicator for the existence of left ventricular hypertrophy. The objective of the study was to determine the relationship between lipid profile and left ventricular mass in adolescent with obesity. It was an analytic observational study using cross sectional method on 40 obese adolescents and 40 non-obese adolescents aged 13-18 years from August 2013 to February 2014. The data included anthropometry size in obese and non-obese adolescents, lipid profile levels of total cholesterol, high-density lipoprotein (HDL), low density lipoprotein (LDL) and triglycerides and left ventricular mass were measured using echocardiography. Data was analyzed by Pearson correlation and processed by program Statistical Product and Service Solutions (SPSS) version 22. There is a very significant different of total cholesterol, LDL, andtriglycerides levels in obese and non-obese adolescents ($p < 0.001$), similarly obtained left ventricular mass, but no significant different in HDL cholesterol ($P = 0.127$). No significant association was found between total cholesterol levels ($r = -0.22$, $p = 0.86$), LDL ($r = -0.163$, $p = 0.16$), HDL ($r = -0.253$, $p = 0.06$) and triglycerides ($r = -0.132$, $p = 0.21$) with left ventricular mass in obese adolescents.There is a very significant different of total cholesterol, LDL, and triglycerides levels in obese and non-obese adolescents, similarly obtained left ventricular mass, but no significant different in HDL cholesterol. Lipid profile is not related to left ventricular mass in obese adolescents.
Keywords: lipid profile, left ventricle mass, obesity.

INTRODUCTION

Obesity is related to abnormalities in the function of cardiac muscle, it has been reported from earlier studies that obese children have a greater left ventricular mass, thicker walls and largercardiac chambers compared to non-obese [1-3]. Obesity in children that precedes into adulthood will cause a disruption in left ventricular systolic function and severe disruption on left ventricular diastolic function. In children with obesity there is an increased body's metabolic need due to the excess weight, it will result in higher total blood volume and cardiac output and lower total peripheral vascular resistance, so the cardiac of children with obesity will work harder to supply blood to the organs compared to normal children [4].

Excessive accumulation of fat in non-adipose cells of obese childrencan causes cell dysfunction and death (lipotoxicity). This abnormal cellular adaptation will also affect the cardiac muscle so that it will lead to cardiomyopathy [5]. Dyslipidemia which is the abnormal changes in cholesterol levels is one of the complications of obesity [6]. By considering the the above condition, this study was conducted to examine the relationship between lipid profile (total cholesterol, LDL, triglycerides, and HDL) and left ventricular mass in obese adolescents.

METHODOLOGY

Analytic observational study conducted with a cross-sectional approach to determine the relationship between lipid profile and left ventricular mass in obese and non-obese adolescents in junior high and high school in the city of Manado, from August 2013 until February 2014. The subject was adolescent aged 13 - 18 years in junior high school and high school in the city of Manado. Exclusion criteria included congenital heart disease, acquired heart disease and metabolic disorders.

Once the parents agreed to participate and are willing to sign a consent form this was then continued with recording the identity, measurement of body weight (BW), body height (BH), the calculation of body mass index (BMI), and physical examination. Body mass index (kg / m^2) is a BW (kg) divided by the square of BH (m^2), obese if the BMI by age and sex is more than or equal to the 95th percentile Center for Disease Control and Prevention (CDC) in 2000, then conducted laboratory tests that is the examination of total cholesterol, LDL, HDL and triglycerides and subsequent measurement of left ventricular mass using echocardiography.

The data was reported in form of distributive tables. For parametric data expressed in the mean, standard deviation (SD) and the confidence index (CI) of 95%, while non-parametric data is expressed in median, minimum and maximum values. Data analysis was performed by t test for unpaired 2 groups (independent samples T test) when the data in the two groups of normal spreads, Mann Whitney test was used when one of the group of data is not normally spread by using the program Statistical Product and Service Solutions (SPSS) version 22.

RESULTS

In this study 40 obese adolescents was obtained, 15 (37.5%) males and 25 (62.5%) females. As for the control, 40 adolescents who were non-obese amongst them 14 (35.0%) were males and 26 (65.0%) were females who voluntarily participated in study. There are significant differences between left ventricular mass in children with obesity compared with children with normal weight ($p < 0.001$). Total cholesterol levels of obese children were higher and significantly different than control ($p < 0.001$), as well as LDL cholesterol in obese higher than children than in normal weight ($p < 0.001$). HDL cholesterol levels among obese children were lower compared with controls ($p = 0.127$) and triglyceride levels were higher in obese children ($p < 0.001$).Age and height mean of the two groups were not statistically different. The results can be seen in Table 1. In the Pearson correlation test, no significant association was found between total cholesterol levels ($r = -0.22$, $p = 0.86$), LDL cholesterol ($r = -0.163$, $p = 0.16$), HDL cholesterol ($r = -0.253$, $p = 0.06$) and triglycerides ($r = -0.132$, $p = 0.21$) and left ventricular mass.

Table 1: Characteristic of the study subject

Variable	Obese n = 40	Non-obese n = 40	p value
Male gender, n (%)	15 (37.5%)	14 (35.0%)	0.816
Age, mean (SD) yr	15.1 (1.3)	15.4 (1.3)	0.18
Weight, mean (SD) kg	83.11 (108.8)	47.7 (6.6)	<0.001
Height, median (SE) cm	158.29(9.93)	160.67(8.19)	0.124
Body Mass Index, mean (SD) (kg/m^2)	32.99(3.55)	18.53(2.30)	<0.001)
Arm circumference , mean (SD) cm	36.9 (4.3)	27.8 (4.9)	<0.001
Neck circumference, mean (SD) cm	45.2 (48.8)	26.7 (3.46)	<0.001
Waist circumference, mean (SD) cm	141.1 (189.5)	68.3 (5.4)	<0.001
Thigh circumference, mean (SD) cm	144.3 (31.0)	82.2 (8.51)	<0.001
Total cholesterol, mean(SD) mg/dl	194.25(41.52)	160.88(24.72)	<0.001
Trigliserida, mean(SD)mg/dl	113.10(42.13)	69.68(28.99)	<0.001
LDL, mean(SD)mg/dl	136.63(41.82)	104.65(25.32)	<0.001
HDL, mean(SD)mg/dl	46.13(9.73)	48.40(7.91)	0.127

DISCUSSION

In obesity, fat deposits do not onlycause increase of fat deposits on adipose tissue in the classic location only, but also in other organs. With increasing fat, fat deposits can cause tissue damage and organ dysfunction through two possibilities, first the layer of fat surrounding the vital organs will be increased so it can affect the function of these organs due to compression and because fat cells surrounding that would secrete some local molecular responses and also the accumulation of fat in non-adipose cells which would lead to cell dysfunction and death, a phenomenon called lipotoxicity [7]. Obesity is a factor that stands alone and is not affected by diabetes and hypertension in influencing the structure and function of the left ventricle. Early detection of disruption of left ventricular structure and function can prevent the occurrence of myocardial dysfunction that can cause increased mortality and cardiovascular morbidity in obese people [8].

In this study, sample of adolescents aged 13-18 years because on previous research said that the prevalence of obesity will increased in such age. In Indonesia, Riskesdas 2010 reported the prevalence of obese adolescent aged 13-15 years in the province of North Sulawesi was 3.4%, while those aged 16-18 years was 2.1% of the entire population [9].

In this study, 40 obese adolescents, found fewer males than in females of 15 (37.5%) males and 25 (62.5%) female. Previous research by Friberg P *et al*.

[10] and Avelar E *et al*. [11] also get fewer males than female, while research by Simsek E *et al*. [12] and Stabouli *et al*. [13] which reported that more males than females, but from these studies, no significant association are found in the incidence of obesity in males and females. *Riset Kesehatan Dasar* (Riskesdas) in 2007 reported that the prevalence of overweight in children aged 6-14 years were 9.5% males and 6.4% in females [14].

In this study there was a significant relationship between left ventricular mass in children with obesity compared with children with normal weight ($p < 0.001$), also found differences in the levels of total cholesterol ($p < 0.001$), LDL cholesterol ($p < 0.001$), Tg cholesterol ($p < 0.001$), but no differences were found between HDL cholesterol levels of obese children with controls ($p = 0.127$).

Left ventricular hypertrophy found in obese is usually associated with left ventricular systolic function and decreased left ventricular diastolic dysfunction [1]. Obesity is related with abnormalities in the function and cardiac muscle, It is proved by studies which reported that children with obesity has a greater left ventricular mass, thicker walls and greater chambers of the heart than those who are not obese. The deviation from the structure and left ventricular mass is very important to know because left ventricular hypertrophy is one of the important risk factor for cardiovascular morbidity and mortality and an increase in left ventricular wall thickness showed increased risk factor cardiomyopathy [1].

In this study, mean of total cholesterol, LDL cholesterol, triglycerides and HDL in obese adolescents are within normal limits, however, from 40 samples there were 13 obese adolescents with total cholesterol above 200 mg/dl with the highest total cholesterol of 320 mg/dl, 11 people with LDL above 150 mg/dl with the highest LDL 259 mg/dl, and HDL below 35 mg/dl was found in three adolescents, triglycerides above 200 mg / dl was found in one adolescent. The results of this study are not much different from the results of previous studies by Ghanem S *et al*. [15] which got total cholesterol 188 ± 32.4 mg/dl, HDL 46.7 ± 6.2 mg/dl, triglycerides 125.4 ± 30.6 mg/dl and LDL cholesterol 115.3 ± 26 mg/dl, the same result was also found in other previous studies [12, 16]. However, in children or adolescents with obesity, the lipid profile should still be monitored because several previous studies found that overweight and obese children are tended to occur abnormal changes in cholesterol levels (dyslipidemia) and also some other cardiovascular risk factors such asinsulin levels, increase in c-reactive protein (CRP) and increased blood pressure [6, 17].

Dyslipidemia is a risk of obesity in children, where there is an increase in low-density lipoprotein cholesterol (LDL) and decrease in high-density lipoprotein (HDL). It is known that increased LDL and decreased HDL are associated with atherosclerosis [6, 18]. HDL cholesterol is circulating lipoproteins, which generally function as atheroprotective. HDL carries cholesterol from the liver to the cells. HDL transports cholesterol from peripheral tissues, including atherosclerotic plaque for being recirculated or discharged in the form of bile acids. High levels of low-density lipoprotein (LDL) cholesterol andlow levels of High-Density Lipoprotein (HDL) cholesterol areindependentrisk factors for cardiovascular disease.18HDL cholesterol plays a role in increasing the expenditure from macrophages, HDL has an important role as an anti-inflammatory and has antioxidant effects [6, 19].

In obesity, fat accumulation in non-adipose cells will lead to excessive cell dysfunction and death of these cells (lipotoxicity). This abnormal cellular adaptation will also affect the cardiac muscle that would lead to cardiomyopathy. Lipotoxicity is a metaplastic phenomenon, because there is are versible change from a mature cell types (epithelial and mesenchymal) to another cell types. Cells that exist between the muscle fibers are accumulated by fat or degeneration of myocytes that will cause the heart defect. Eventually all parts of the myocardium from the atrioventricular region will be replaced by fat [6, 20].

In the Pearson correlation test, there is no significant relation between total cholesterol levels ($r = -0.22$, $P = 0.86$), LDL cholesterol ($r = -0.163$, $P = 0.16$), HDL cholesterol ($r = -0.253$, $P = 0.06$) and triglycerides ($r = -0.132$, $p = 0.21$) to left ventricular mass. This is most likely due to most of the samples in this study were obese adolescents who are not hypertensive (normotensive) and the levels of lipid profile values were still within the normal range of high but not yet eligible to dyslipidemia as in previous studies that reported meaningful results. The Goal of this study is to see the effect of the lipid profile of the left ventricular mass without the influence from other factors. Study by Sorof *et al*. [8] reported that the increase in blood pressure is related to left ventricular hypertrophy in hypertension children. Systolic hypertension in adults reported from studies is closely related to cardiovascular disease morbidity and mortality. Systolic hypertension has an important role in the onset of early lesions in the vascular endothelium. Blood pressure is a prognostic factor of morbidity and mortality of coronary artery disease and stroke in adults, but studies in children are not yet able to explain the effect of obesity and hypertension on left ventricular mass increase [11, 21].

The limitation of this study is that it is a cross-sectional research design and therefore cannot accurately evaluate the other risk factors that may lead to an increase in left ventricular mass. In this study, it is not evaluated how the obesity in term of long exposure

affect the increase in left ventricular mass and it can be concluded that there is a very significant different of total cholesterol, LDL, and Tg levels in obese and non obese adolescent, similarly obtained left ventricular mass, but no significant different in HDL cholesterol. The levels of lipid profiles (total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides) are not related to increased left ventricular mass, but the lipid profile in children or adolescents with obesity should still be monitored because there can be abnormal changes of cholesterol levels (dyslipidemia) which can be a cardiovascular risk factor.

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