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Blood lipid of preadolescent boys of well-to-do families

Muzief Munir, Sudiro Darmoprawiro

Department of Child Health, Medical School, Trisakti University - Mintoharjo Naval Hospital, Jakarta

ABSTRACT Coronary heart disease is presently one of the leading causes of death in adults in many countries, including in Indonesia. It is well known that elevated levels of cholesterol in children are closely associated with hypercholesterolemia and coronary heart disease in adult life. This study was conducted in an attempt to find a preliminary insight of the magnitude of the problem of hypercholesterolemia in children in Indonesia as a developing country. The blood lipid levels of 54 preadolescent boys from well-to-do families were analyzed. Two third of those children were shown to have elevated blood cholesterol level, and even one third or 16 out of 54 preadolescents boys investigated suffered from hypercholesterolemia. We conclude that elevated blood cholesterol level is frequently found among large-framed and obese Indonesian children. **[Paediatr Indones 2001;41:19-26]**

Keywords: *blood lipid level, cholesterol, preadolescent boys, coronary heart disease prevention*

CORONARY HEART DISEASE IS THE LEADING CAUSE OF adult morbidity and mortality in the developed world.[1] In Indonesia as a developing country, based on household surveys conducted by Department of Health in 1986 and 1992, in just six years the main cause of death shifted from diarrheal diseases in 1986 to cardiovascular diseases in 1992. It is also reported that the prevalence of coronary heart diseases (CHD) was found in younger ages. Although the etiology of CHD is multifactorial, one of the main risk factors for the development of coronary heart disease is high concentration of blood cholesterol, particularly the elevation of low density lipoprotein cholesterol (LDL-c), which is the leading cause of the development of a progressing process of atherosclerosis.[1-7] Coronary atherosclerosis usually begins in early life, particularly in adolescence and young adults, and its effects continue to cumulate until adulthood.[7-12] The Bologusa heart study[10] showed a positive correlation of LDL-c level with the degree of aortic wall involvement with fatty streaks: a group of children with cholesterol level between 140-170 mg/dl had approximately 25% involvement, while in a group with a level greater than 200 mg/dl, the involvement was doubled. It is evident that high concentration of blood cholesterol and LDL-c during childhood leads to hypercholesterolemia in adulthood. In children with initial cholesterol levels greater than the 90th percentile in a single measurement, 43% were found to have levels greater than the 90th percentile at 20-30 years of age, with 62% greater than the 75th percentile and 81% greater than the 50th percentile at adult ages. So that prevention of coronary heart disease in adulthood should start during childhood.

Hypercholesterolemia is closely associated with a high fat diet, low physical activity, familial history of myocardial infarction or familial high serum cholesterol, and smoking.[13] Many risk factors might be responsible for the development of cardiovascular diseases in Indonesia. These include cooking with tropical oils, smoking, little physical activity as the result

Correspondence: Professor Muzief Munir, MD, Department of Child Health, Medical School, Trisakti University, Jalan Kiai Tapa, Jakarta, Indonesia.

of significant developments in communication and transportation technology, and the trend of increasing prevalence of obesity. This study was conducted in an attempt to secure a preliminary insight into the problem of hypercholesterolemia in preadolescent boys of well-to-do families in order that necessary measures could be undertaken at earlier ages to prevent coronary heart disease in the adult population.

Methods

Subjects for this study were 10-11 year old boys, selected randomly from Al Azhar elementary school, Kebayoran Baru, Jakarta, Indonesia. This was a private school mainly served the well-to-do families. Every child was asked not to take any food during the night and in the morning before having blood drawn for total cholesterol, LDL-c, HDL and triglyceride examinations. Body height and weight were measured to calculate body mass index as follows: BMI = weight in kg/height in meters square. By using Canadian standards from the anthropometry report,[14] the statures were grouped into, short (25th or less percentile), medium (25-75thpercentile) and tall (75th percentile or more). Based on the body mass index, the studied population were grouped into: (1). Normal frame (BMI was less than 90th percentile; (2) Large frame or overweight (BMI was 90th percentile or more).

By using height and BMI the body form of children were divided into 6 groups:

1. Short with large frame (height, 25th percentile or less, and BMI 90th percentile or more)
2. Short with normal frame (height, 25th percentile or less, and BMI is less than 90th percentile)
3. Medium with normal frame (height, 25-75th percentile and BMI less than 90th percentile)
4. Medium with large frame (height, 25-75th percentile and BMI 90th percentile or more)
5. Tall with normal frame (height, 75th percentile or more, and BMI less than 90th percentile)
6. Tall with large frame (height, 75th percentile or more, and BMI 90th percentile or more)

Two measurements were taken for height and weight; a third measurement was required if the first two measurements differed by more than 0.5 cm for height and 0.3 kg for weight. The two measurements for height and weight were averaged, and if three measurements were obtained, the two closest measurements were averaged. Body fat was demonstrated by measuring skin fold thickness with a Lange skinfold caliper at the triceps, subscapular, abdomen, and suprailiac sites, expressed in millimeters. Based on TSF thickness, body fat measurements were categorized into normal body fat composition (TSF was 75th percentile of the standard for age), high risk for obesity (TSF was 75-90th percentile), and obese (TSF was more than 90th percentile of the standard).

Blood cholesterol levels were grouped and defined as follows. Total blood cholesterol levels were considered: (1). Normal or acceptable total cholesterol levels: total blood cholesterol less than 175 mg/dl; (2). Moderate elevated or high-risk-to-be hypercholesterolemia: total blood cholesterol between 175-200 mg/dl; (3). High concentration or hypercholesterolemia: total cholesterol 175 mg/dl or more. For LDL-c: (1). Normal or acceptable LDL-c concentration: LDL-c concentration of less than 110 mg/dl; (2). Moderate elevated LDL-c concentration : LDL-c concentration of 110-129 mg/dl; (3). High concentration of LDL-c : LDL-c concentration of 130 mg/dl or more.

Habitual physical exercise was recorded by using a modified instructive questionnaire of Godin and Shephard.[15] Based on those questionnaires, the studied subjects were categorized into low-physical exercise and high physical exercise groups.

Results

Relationship of body frame and blood lipids

Fifty-four boys were studued consisting of 24 normal-framed (BMI less than 90th percentile), and 30 large frame children (BMI 90th percentile or more). The prevalence of high cholesterol level of more than 200 mg/dl and elevated LDL-c of more than 110 mg/dl were significantly higher in large-framed children than those with normal frames, with the relative risk of hypercholesterolemia of 1.1 in medium-framed and 1.9 in large-framed children. See Tables 1 and 2.

Types of body fat and blood cholesterol

The prevalence of high cholesterol levels of more than 200 mg/dl and elevated LDL-c of more than 110 mg/dl was significantly higher in obese than in non-obese children, with the relative risk of 1.6 in group of high-risk and was 2.85 in obese (Tables 3 and 4).

TABLE 1. ASSOCIATION OF BODY MASS INDEX AND BLOOD CHOLESTEROL LEVEL

	Cholesterol			
		Elevated		
BMI	**Acceptable (< 175 mg%)**	**Moderate elevated (175-200 mg%)**	**Hypercholesterolemia (> 200 mg%)**	**Total**
Normal frame	14 (50%)	8 (40%)	2 (10%)	24
Big frame	8 (27%)	8 (27%)	14 (47%)	30
Total	**22 (41%)**	**16 (30%)**	**16 (30%)**	**54**

$X^2 = 17.1610$ df = 4 $p < 0.00$

TABLE 2. ASSOCIATION OF BODY MASS INDEX AND LDL LEVEL

	LDL			
		Elevated		
BMI	**Acceptable (< 110 mg/dl)**	**Moderate elevated (110-129 mg/dl)**	**High (> 129 mg/dl)**	**Total**
Normal	20 (80%)	2 (10%)	2 (10%)	24
Big frame	11 (37%)	12 (40%)	7 (23%)	30
Total	**31 (57%)**	**14 (26%)**	**9 (17%)**	**54**

$X^2 = 12.8762$ df = 4 $p < 0.01$

TABLE 3. ASSOCIATION OF BODY FAT APPEARANCE AND BLOOD CHOLESTEROL

	Cholesterol			
		Elevated		
Body fat	**Acceptable (< 175 mg%)**	**Moderate elevated (175-200 mg%)**	**Hypercholesterolemia (> 200 mg%)**	**Total**
Normal	7 (78%)	2 (22%)	-	9
Fatty (High risk to be obese)	6 (50%)	4 (33%)	2 (17%)	12
Obese	9 (27%)	10 (30%)	14 (32%)	33

$X^2 = 11.0621$ df = 4 $p < 0.05$

TABLE 4. ASSOCIATION OF BODY FAT APPEARANCE AND LDL

	LDL			
		Elevated		
Body fat	**Acceptable (< 110 mg%)**	**Moderate elevated (110-129 mg%)**	**High (> 130 mg%)**	**Total**
Normal	9	-	-	9
Fatty	9 (75%)	2 (17%)	1 (8%)	12
Obese	13 (39%)	12 (36%)	8 (24%)	33

$X^2 = 13.3255$ df = 4 $p < 0.005$

TABLE 5. ASSOCIATION OF BLOOD LIPID AND BODY MASS INDEX (MEAN ± SE)

	Normal Frame (< 90 percentile) n = 24	**Big Frame (> 90 percentile) n = 30**	
Total Cholesterol	174.33 ± 4.17	195.73 ± 4.66	p<0.01*
LDL	97.92 ± 5.59	118.20 ± 4.30	p<0.05**
HDL	56.29 ± 2.37	55.80 ± 1.46	NS
Triglyceride	81.29 + 10.98	114.47 ± 13.47	NS

TABLE 6. RELATION OF BLOOD LIPID AND PHYSICAL SIZE (MEAN ± SE)

	Short		Medium High		Tall	
	Normal frame (n = 9)	Big frame (n = 6)	Normal frame (n = 6)	Big frame (n = 8)	Normal frame (n = 9)	Big frame (n = 16)
Tot. Cholesterol*	170.4 ± 5 (138 - 194)	199.6 ± 11.87 (171-240)	163.7 ± 4.69 (150 - 184)	197.0 ± 6.30 (175-221)	185.2 ± 5.45 (169-220)	195.6 ± 7.37 (143-235)
LDL**	93.2 ± 6.78 (60-127)	121.6 ± 11.27 (95-162)	87.8 ± 5.93 (65-102)	120 ± 6.95 (94-153)	107.2 ± 7.39 (85-160)	119.0 ± 6.94 (68-175)
HDL #	58.9 ± 3.03 (45-69)	57.6 ± 1.03 (54-60)	54.5 ± 3.15 (44-63)	54.0 ± 2.08 (43-75)	54.0 ± 2.08 (47-63)	56.8 ± 1.90 (36-69)
Triglyceride #	68.2 ± 11.97 (39-170)	90.2 ± 14.60 (54-126)	95.0 ± 15.39 (46-156)	131.4 ± 35.09 (63-373)	97.4 ± 15.69 (38-180)	115.6 ± 17.60 (58-347)

* Significant ($p < 0.01$); ** Significant ($p < 0.05$); # NS

TABLE 7. RELATION OF MEAN BLOOD CHOLESTEROL AND TRICEPS SKIN FOLD

	TSF			
	Normal (< 75th percentile) n = 9 (mean ± SE)	High risk to be obese (< 75-90th percentile) n = 12 (mean ± SE)	Obese (> 90th percentile) n = 33 (mean ± SE)	p
Cholesterol Total	167.2 ± 4.85 (138 - 185)	179.7 ± 5.54 (160-220)	193.7 ± 4.39 (143 + 235)	p < 0.01*
LDL	88.9 ± 5.27 (60-104)	103.7 ± 7.16 (65-160)	111.7 ± 4.36 (68-175)	p < 0.01
HDL	57.7 ± 3.38 (44-73)	56.9 ± 1.88 (46-68)	55.4 ± 1.36 (36-75)	NS
Triglyceride	83.8 ± 12.96 (39-170)	77.0 + 10.45 (38-159)	112.0 ± 12.56 (52-373)	NS

Blood cholesterol and physical size

Table 5 shows that the mean total cholesterol and LDL-c levels of large frame pre-adolescent boys were significantly higher than those in normal and medium frames. The mean blood cholesterol in large frames was 195.7 mg/dl, in medium and small frames it was 178.0 mg/dl and 155.8%, respectively. While the mean concentration of LDL-c in large frames was 118.2 mg/dl, and in medium and small frames it was 101.8 mg/dl and 78.3 mg/dl, respectively. Table 6 shows that the mean total cholesterol and LDL-c in tall, normal height an short large frames were significantly higher than those in normal frames. The highest concentration of cholesterol and LDL-c was found in short large frame children with their mean concentration of 199.6 mg/dl and 121.6 mg/dl respectively.

Table 7 shows that the mean total cholesterol of 193.8 mg/dl and 111.7 mg/dl of LDL-c in a obese children was significantly higher than that of, respectively, 167.2 mg/dl and of 88.9 mg/dl in normal reference children.

Table 8 shows that the mean total cholesterol and LDL-C in obese short, medium and tall children were significantly higher than that in non-obese. However, the mean total cholesterol of 186.8 mg/dl, and LDL-C of 112 mg/dl in normal tall children were the concentration levels of high risk to develop atherosclerosis.

Table 9 shows that the mean total cholesterol and LDL-c in both large and normal frames of low activity children were significantly higher than that in those of high physical activity. The mean total cho-

TABLE 8. RELATION OF MEAN BLOOD CHOLESTEROL AND BODY FORM

	Short		Medium		Tall		
	Normal n = 7	Obese n = 8	Normal n = 4	Obese n = 10	Normal n = 6	Obese n = 19	
T. Cholesterol*	164.4 ± 5.31 (138 - 180)	193.9 ± 7.89 (171-240)	165.8 ± 7.13 (150 + 184)	189.5 ± 7.06 (159-221)	186.8 ± 8.06 (169-220)	193.4 ± 6.31 (143-235)	p < 0.01
LDL	83.71 ± 6.65 (60-110)	119.3 ± 6.71 (95-162)	91.0 ± 8.71 (65-102)	112.3 ± 7.54 (78-134)	112.5 ± 10.38 (92-160)	115.5 ± 6.34 (68-175)	p < 0.05
HDL	14.0 ± 3.67 (45-73)	57.0 ± 2.11 (48-680)	52.3 ± 4.44 (44-63)	55.0 ± 3.10 (43-75)	55.0 ± 2.60 (48-61)	56.6 ± 1.75 (36-65)	NS
Triglyceride #	74.4 ± 16.70 (39-170)	76.5 ± 11.27 (44-126)	107.5 ± 18.45 (73-159)	122.1 ± 29.27 (46-373)	84.0 ± 12.67 (38-128)	110.4 ± 15.60 (53-347)	NS

TABLE 9. RELATION OF BLOOD LIPID AND DAILY PHYSICAL ACTIVITY

	Less active with		active with		
	Normal frame n = 10	Big frame n = 12	Normal frame n = 15	Big frame n = 17	p
T. Cholesterol*	177.6 ± 2.90 (164 - 200)	205.4 ± 6.74 (165-235)	171.7 ± 5.23 (138 + 220)	190.7 ± 6.25 (143-240)	p < 0.01
LDL	99.3 ± 3.77 (79-122)	124.7 ± 5.37 (94-153)	95.4 ± 6.67 (60-160)	116.2 ± 6.80 (68-175)	p < 0.01
HDL	58.8 ± 1.58 (52-69)	56.0 ± 2.40 (36-69)	54.8 ± 2.49 (44-73)	56.5 ± 1.83 (45-75)	NS
Triglyceride #	77.1 ± 8.69 (38-128)	137.3 ± 21.41 (59-347)	82.2 ± 11.32 (39-170)	102.0 ± 17.68 (54-373)	NS

lesterol of low physical activity was 205.42 mg/dl comparing to 190.47 mg/dl for large frame high physical activity children.

Discussion

Surprisingly, one third or 16 out of 54 (30%) preadolescent boys of well-to-do families in our studies were hypercholesterolemic with a total blood cholesterol of 200 mg/dl or more, and almost another one third or 15 of those subject studies were high risk hypercholesterolemia. It is widely well accepted that children with blood cholesterol of more than 175 mg/dl should be treated as elevated levels of blood cholesterol and should be followed up routinely during their life. These findings were much higher than those reported from Western World, where the prevalence of hypercholesterolemia in children was less than 10% and only one fourth had cholesterol level more than 175 mg/dl.[5,6] Since LDL-c is closely related to atherosclerosis, the elevation of LDL is a more important indicator in the development of cardio-vascular diseases. Nearly half of our subject studies or 23 out of 54 showed an elevation of LDL, even 9 of them with high concentration of more than 130 mg/dl. These children if not treated now, many years later during their adulthood will suffer from cardiovascular diseases since LDL-c and HDL-c, and their risks were affected by a number of life styles, including of obesity, level of exercise, cigarette smoking, and also alcohol consumption.

Since our findings showed that the prevalence of hypercholesterolemia and high concentration of cholesterol of more than 175 mg/dl were high among preadolescent boys of well-to-do families, early identification of children with a high risk of hypercholesterolemia followed by nutritional and medical interventions are very important efforts to prevent future coronary heart disease. Garcia and Moodie (1989) based on their findings, suggested that all children over 3 year of age should have a routine cholesterol test in an effort to avoid a high-risk coronaty life style behavior during their further life.[14] However, due to medical and technical disadvantages and limitations, it is not rational to recommend for routine blood cholesterol examination to all Indonesian preadolescents boys. High cost, lack of laboratory facilities, poor laboratory standardizations, and diurnal and seasonal effects on blood cholesterol, are among those disadvantages and limitations.

It has been recommended to screen for high cholesterol levels only in children with a family history of hypercholesterolemia or coronary heart disease.[17-18] On contrary, Wong et al[19] reported controversial findings that there was no association of parent or grandparent history of premature myocardial infarction with a child's cholesterol level, but a positive family history of a high cholesterol level was modestly associated with an increased probability of having high cholesterol level with a relative risk of 1.6. It was proved that due to strict criteria limited to those with a positive family history as the only indicator, many children with elevated cholesterol values are missed, and during their adult life suffer from coronary heart disease.[20-21] A flexible and broader criteria for screening hypercholesterolemia is needed to avoid uncovered cases.

Physical appearances such as body fatness and BMI can be used as one of the screening criteria for routine detection of hypercholesterolemia. Based on population studies of children and adolescents, excess subcutaneous fatness was associated with elevated blood pressure, serum lipids and lipoprotein fraction.[22-25] Obesity is known as the most prominent coronary heart disease risk factor since obese adolescent have a high incidence of multiple coronaty heart disease risk. On the other hand obesity is also an independent risk factor for CHD, as the correlation of obesity and CHD is independent of age, serum cholesterol, blood pressure, cigarette smoking, or glucose intolerance.[26] By using body fat patterns, our findings showed that the prevalence of hypercholesterolemia, a and high concentration of LDL-C in obese subjects were significantly higher than those in normal non-obese. The mean blood cholesterol and LDL-c in obese particularly in short obese subjects were significantly higher than those in non obese, and they were much higher than their 75th percentiles.

Since our findings also showed that in tall-non-obese subjects the mean total cholesterol and LDL-c were much higher than those of their 75th percentile, 175 mg/dl for total cholesterol and 110 mg/dl for LDL-c, a tall non-obese could also be included as risk factor in the development of coronary heart disease in their future life. As in obese subjects, the mean total blood cholesterol of and LDL-c in large frame or overweight, particularly in short overweight subjects with total blood cholesterol of 199.6 mg/dl and with LDL-c of 121.6 mg/dl were significantly higher than those in normal frame, and they were much higher than the level of their 75th percentile. In a tall normal frame the mean total cholesterol and LDL-c concentration were normal, below their 75th percentile.

It is well known that physical activities, defined as any bodily movement that results in energy expenditure in adult and adolescent, determine blood cholesterol concentration particularly increasing HDL-c concentration.[27] Since different methods of assessing children's physical activities, the effects of physical activities on blood cholesterol are controversial. Only few studies have been conducted regarding the effect of physical exercise, or habitual physical activity, or both on serum lipid and lipoprotein levels. Whereas Thorland and Gillian[28], Yamamoto et al[29] and Macek et al[30] reported there was a direct association between physical activity and HDL concentration, Sallis et al[31] reported no effect. Our findings based on structured-interview-method showed that total cholesterol and LDL-c in normal frame and in large frame or overweight subjects of less active subjects were significantly higher than those physically active subjects. But the concentration of HDL-c and triglyceride did not show statistically different between less active and active subjects (Table 9).

The vast majority of less active subjects spent their time through watching television. Watching television is definitely one kind of low physical activity and duration of television watching is found to be one of the predictors for elevated blood cholesterol in children. Wrong et al also reported that excessive television watching of more than 4 houts per day showed to be a strongest predictive screen for elevated cholesterol values of 200 mg/dl or more with a relative risk of 4.8 and 2.2 if television is watched 2-4 hours per day when compared to those watching less than two hours per day. Our findings have clearly shown that adolescent children who had with low physical activities had a significantly higher cholesterol and LDL-c levels than those children with high physical activities.

We conclude that a significant percentage of pre-adolescent boys of well-to-do families in Jakarta are found to have a moderate and high level of blood cholesterol. Surprisingly, the figure in fact is much higher than that reported from studies in developed countries. In attempt to find out the magnitude problems of coronary heart disease risk factors in Indonesian community, it is necessary to conduct studies in Indonesian communities with their difference grounds.

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