Original Article

Association between serum cholesterol levels and nutritional status in school children aged 10-12 years

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ABSTRACT

Background Hypercholesterolemia in children is an important risk factor that causes coronary heart disease in the future. Nutritional status, especially overweight/obesity, is associated with hypercholesterolemia.

Objective To determine the prevalence of hypercholesterolemia and its association with nutritional status.

Methods This was a cross sectional study conducted during April-June 2001. Subjects consisted of children aged 10-12 year-old registered at primary schools in Manado, Tondano, and Tandengan Minahasa. Data were analyzed using t test, z score, and chi-square.

Results Of the 229 samples, 153 (66.8%) were boys and 76 (33.2 %) were girls. The mean of total cholesterol level in boys was 179.46 mg/dL (SD 33.44) and in girls was 180.95 mg/dL (SD 33.77) which was not significantly different (p>0.05). There were no differences in either the number of children having "borderline" cholesterol level (170–199 mg/dL) or hypercholesterolemia ($\geq$200 mg/dL) between both sexes. Of the 229 children, 65 (28.4%) had hypercholesterolemia. Of the 65 children, 37 (36%) came from the primary school in Manado, which was significant compared to the other school locations (p<0.05). Twenty-five (39%) children with hypercholesterolemia had overweight nutritional status, which was significant compared to the other nutritional status (p<0.05).

Conclusion The prevalence of hypercholesterolemia was 28.4 %. There was an association between hypercholesterolemia and nutritional status, with a tendency of hypercholesterolemia to occur at overweight nutritional status, especially in the urban area **[Paediatr Indones 2003;43:73-76].**

Keywords: Hypercholesterolemia, obesity, school age children.

Hypercholesterolemia in children which persists until adult period is one of the important risk factors of coronary heart disease and atherosclerosis.[1-4] More than half of atherosclerotic process and coronary vessels fattening start to begin at the age of 10-14 years.[5-7] Hypercholesterolemia at the age of 12 years is a good prediction for an adult hypercholesterolemia.[8] Cholesterol blood level depends on many factors, such as gender, genetic, race, geography, environment, nutritional status, and measurement method.[4,5] The increase of total cholesterol level in a child develops naturally together with the child growth in age and achieves its peak level at the age of 8-11 years.[8,10] There is a correlation between nutritional status and cholesterol level. An overweight or especially obese child tends to suffer from hypercholesterolemia.[4,11,12]

The aim of this study was to determine the prevalence of hypercholesterolemia, the mean level of total cholesterol, and the association between hypercholesterolemia and nutritional status in school children aged 10-12 years in Manado as an urban area and Tondano, Tandengan, and Minahasa as rural areas.

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TABLE 1. TOTAL CHOLESTEROL LEVEL ACCORDING TO SCHOOL LOCATION

Total cholesterol level (mg/dL)	SDK Fr. Don Bosco Manado n=103	SDN IV Tondano Minahasa n=104	SDN Tandengan Minahasa n=22	Total n=229
<170	36 (34.9%)	34 (32.7%)	17	87 (38.0%)
170–199	30 (29.2%)	44 (42.3%).*	3	77 (33.6%)
≥200	37 (35.9%)	26 (25.0%)	2	65 (28.4%)

* $p<0.05$, $x^2=20.887$

TABLE 2. NUTRITIONAL STATUS (WT/HT) ACCORDING TO SCHOOL LOCATION

Nutritional Status (wt/ht)	SDK Fr. Don Bosco Manado n=103	SDN IV Tondano Minahasa n=104	SDN Tandengan Minahasa n=22	Total n=229
overweight (>100 %)	47 (45.6%).*	36 (34.2%)	0	83 (36.2%)
Good (90 – 100 %)	30 (28.8%)	46 (44.7%).*	8	84 (36.7%)
Low (70-< 90 %)	25.9 (20%)	22 (21.4%)	13	60 (26.2%)
Under (< 70 %)	1 (1.0%)	0 (0%)	1	2 (0.9%)

*$p<0.05$

Methods

This was a cross-sectional study on school children aged 10-12 years, registered at a primary school in Manado and two primary schools in the regency of Minahasa. The study was conducted from April until June 2000. We chose those locations because they were easy to reach. The reason for choosing children aged 10-12 years was because they could cooperate for this study and at that age, the peak of the total cholesterol level can be detected and atherosclerosis process as well as coronary fattening begins.

Total cholesterol level was checked at the Prodia clinic laboratory with enzymatic hydrolysis and oxidation. The employees of the Prodia laboratory took the blood samples. The classification of the level of total cholesterol was based on the National Cholesterol Education Program (NCEP) criteria i.e., acceptable (<170 mg/dL), borderline (170-199 mg/dL), and hypercholesterolemia (≥200 mg/dL).

Nutritional status was based on weight for height according to Lokakarya Antropometri 1975 and Puslitbang Gizi 1978[13] i.e., overweight (>100%), good (100-90%), low (<90-70%), and under nutritional status (<70%). Measurement of body weight used weight scale digital that had an accuracy of 0.1 kg. Measurement of height used microtoise, which had a sensitivity of 0.1 cm. All children in this study got informed consent from their parents.

Data were analyzed using t-test and z score to determine a difference in the level of significance of $p<0.05$ and chi-square (X^2) to determine an association of nominal data.

Results

Subjects were 229 children consisting of 153 (66.8%) boys and 76 (33.2%) girls. The mean of total cholesterol level in boys was 176.46 mg/dL (SD 33.44) and in girls were 180.95 mg/dL (SD 30.77). There was no significant difference between them ($p>0.05$). Of the 229 children, 65 (28.4%) had hypercholesterolemia, 29% were boys and 26% were girls. Seventy-seven children (47 boys and 30 girls) had borderline total cholesterol level. There was no significant difference between gender in either borderline cholesterol level or hypercholesterolemia ($p>0.05$).

Table 1 shows total cholesterol level according to school location. Of 103 children at the primary school in Manado, 37 (35.9%) had hypercholesterolemia. This prevalence was significantly different with that in the other two locations in Minahasa, 26 (25.0%) of 104 children in Tondano and 2 of 22 children in Tandengan ($p<0.05$). There was a correlation between hypercholesterolemia and school location ($X^2=20.887$). Of 65 children who had hypercholesterolemia, 37 (56.9%) were children in Manado.

Nutritional status (weight/height ratio) according to school location is shown in **Table 2**. The nutritional status got better when it was close to the urban area. Forty-seven (45.6%) children in Manado pri-

TABLE 3. ASSOCIATION OF HYPERCHOLESTEROLEMIA WITH NUTRITIONAL STATUS ACCORDING SCHOOL LOCATION

Nutritional Status (Wt/Ht)	SDK Fr Don Bosco Manado		SDN Tondano Minahasa		SDN Tandengan Minahasa	
	n	Hypercholesterolemia	n	Hypercholesterolemia	n	Hypercholesterolemia
Overweight	48	19	35	6	-	-
Good	30	6	46	11	8	-
Low	25	11	22	9	13	1
Under	1	1	-	-	-	1

$X^2 = 28.962$; *$p < 0.05$

mary school were overweight, it was higher than that in Tondano, Minahasa, 36 (34.2%). No one of 22 children in Tandengan was overweight. On the contrary, 13 children had low nutritional status.

Table 3 shows the correlation between hypercholesterolemia and nutritional status according to school location. From 83 children with overweight status, 48 were in Manado; 19 of them had hypercholesterolemia. Significant difference ($p < 0.05$) was found compared to that in children in Minahasa, which showed only 6 out of 35 children had hypercholesterolemia. Of 65 children who had hypercholesterolemia, 25 (38%) were overweight, 17 (26%) had good nutritional status, 21 (32%) low, and 2 (3%) underweight.

There was a correlation between hypercholesterolemia and nutritional status and school location, in which hypercholesterolemia tended to occur in children with overweight status and in the city of Manado ($X^2 = 28.962$).

Discussion

Cholesterol blood level depends on many factors, among others are age, gender/sex, genetic, race, geography, environment, nutritional status, and measurement method.[4-7] In this study we found the mean of total cholesterol level was 179.46 mg/dL (SD 33.44) in boys and 180.95 mg/dL (SD 30.77) in girls. This result was higher than that of American children for age of 10-14 years i.e., 160 mg/dL for both sexes.[14] It was also higher than that found by other studies; Pelupessy *et al*[15] found that the mean of total cholesterol level was 161.30 mg/dL (SD 28.50) and 160.08 mg/dL (SD 25.93) in boys and girls aged 10-14 years respectively in Ujung Pandang. Schulpis *et al*[16] reported the mean of total cholesterol level at Greek children aged 10-12 years was 157-174 mg/dL in boys and 158-172 mg/dL in girls.

The prevalence of hypercholesterolemia in this study was 28.4%; 3.5 times higher than that reported by Wong *et al*[3] in California, USA, which was 8% only at the age of 10-14 years. Meyerson *et al*[17] found that 50% children aged 2-18 years had hypercholesterolemia.

In this study, no significant difference was found in the mean of total cholesterol level between gender ($p > 0.05$). The same result had been reported by other authors such as Pelupessy, *et al*[15] in Ujung Pandang, Freedman *et al*[18] in California USA[18], and Schulpis *et al*[16] in Greek. However other study reported that the mean of total cholesterol level in girls was higher than in boys.[19]

In this study we found that the prevalence of hypercholesterolemia of children in Manado was higher (35.9%) than that of those in Minahasa. This result was the same as that of several studies conducted in Finland, the United State, and Nigeria; where it was found that children who lived in urban areas had total cholesterol level higher than that of those living in rural areas.[8]

Many factors influence the nutritional status, among others are hereditary factor, socioeconomy, physical activities, habit to consume snack, and consumption pattern of fast food.[11,12,20] In this study, the highest percentage (45.6%) of overweight status was found in children in Manado ($p < 0.05$). It maybe associated with the consumption pattern of fast food or snack that can be afforded by parents who were classified as having middle or high economic status.

The correlation between hypercholesterolemia and overweight status or obesity had been reported frequently.[4,11,12] Tran *et al*[21] reported that the increase of body weight will increase blood cholesterol level significantly, or vice versa.

The increase of lipoprotein due to excessive calorie intake in overweight or obese children will result in hypercholesterolemia or hypertriglyceridemia.[4] In this

study, there was a statistically significant difference in the proportion of children with hypercholesterolemia according to nutritional status, in which overweight children accounted for the greatest proportion (38%).

This study found an association between hypercholesterolemia and overweight status predominantly in children of Manado (urban area) (X^2=28.962)

In conclusion, the prevalence of hypercholesterolemia was 28.4%. The mean of total cholesterol level in children aged 10-12 years was 179.46 mg/dL (SD 3.44) in boys and 180.95 mg/dL (SD 30.77) in girls. There was an association between hypercholesterolemia and nutritional status as well as school location. Hypercholesterolemia tended to occur in children with overweight status and predominantly in urban areas.

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