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Original Article

Blood pressure and lipid profiles in adolescents with hypertensive parents

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Abstract

Background Adolescent hypertension is a significant health problem of increasing prevalence and causes high morbidity and mortality. It is found primarily in young males, with a familial history of hypertension and/or cardiovascular disease. Examination of lipid profiles has been used to detect the risk of hypertension in adolescents.

Objective To compare blood pressure and lipid profiles in adolescents with and without a parental history of hypertension.

Methods This cross-sectional study was conducted from January to February 2012 on students from a senior high school in the Toba Samosir District, North Sumatera. Sixty-eight adolescents were included, aged 15 to 18 years. Group I comprised 34 adolescents with hypertensive parents, and group II comprised 34 adolescents with normotensive parents. Subjects were selected based on questionnaires. Subjects' blood pressures were measured at rest. Three measurements were made in intervals of 10-15 minutes, then averaged for both systolic and diastolic blood pressures. Lipid profiles were measured using the CardioCheck cholesterol test after subjects had fasted for 12 hours.

Results The median systolic blood pressures (SBP) in groups I and II were 110 mmHg (range 93.3-123.3) and 106.7 mmHg (range 96.7-123.3), respectively, (P=0.584). The median diastolic blood pressures (DBP) were 73.3 mmHg (range 66.7-83.3) and 71.7 mmHg (range 63.3-80.0), respectively, (P=0.953). Total cholesterol and low-density lipoprotein cholesterol (LDL-C) levels in group I were significantly higher than those levels in group II [median total cholesterol: 162.0 (range 158-170) *vs.* 159.0 (range 150-170), respectively; (P=0.001); and mean LDL-C: 103.5 (SD 3.72) *vs.* 99.1 (SD 4.63), respectively; (P=0.001). Multivariate analysis revealed a correlation of moderate strength between parental history of hypertension and increased LDL-C (P<0.001) in adolescents.

Conclusion Adolescents with and without familial history of hypertension have no significant median blood pressure differences. However, adolescents with hypertensive parents have significantly higher median total cholesterol and mean LDL-C. Furthermore, we find a correlation between parental history of hypertension and increased LDL-C in adolescents. **[Paediatr Indones. 2015;55:333-8]**.

Keywords: *adolescents, blood pressure, lipid profile, familial history of hypertension*

Adolescent hypertension is an important health problem of increasing prevalence that affects morbidity and mortality.[1] The prevalence of hypertension in adolescents has increased due to several factors such as obesity, a sedentary lifestyle, smoking, stress, sleep disorders and increased intake of high-calorie foods, sodium, alcohol, and caffeine.[2]

In the pediatric population, essential hypertension, also known as primary hypertension, mostly af-

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fects young males, especially those aged 10 to 18 years. It is usually asymptomatic, with familial factors of a history of hypertension and/or cardiovascular disease. The stage of hypertension in adolescents, whether mild, moderate, or severe, temporary or persistent, acute or chronic, requires further evaluation.[2,3] One type of evaluation required to assess essential hypertension is the lipid profile examination. A relationship between increased lipid profile levels and essential hypertension in adolescents has been noted. Some studies have shown that lipid profile exams are important for monitoring changes in those with risk factors such as parental history of hypertension, familial history of hypercholesterolemia, and obesity, since these are associated with cardiovascular changes in adolescents.[4-6] An American study found that 1% of adolescents had BP above the 95th percentile based on age, gender and height.[7] According to the *Riset Kesehatan Dasar 2010* (National Basic Health Research), the prevalence of adolescent hypertension reached 6-15%.[8]

The aim of this study was to compare blood pressures (BP) and lipid profiles between adolescents with and without a parental history of hypertension.

Methods

We conducted a cross-sectional study from January to February 2012 on students from a senior high school (SMA Negeri 2 Soposorung) in Soposorung, Toba Samosir District, North Sumatera. Our inclusion criteria were students aged 15 to 18 years, of normal body weight, and with either hypertensive or normotensive parents. We excluded students who smoke and those with chronic diseases such as kidney diseases, malignancy, cardiovascular abnormalities, and heart disease. Subjects were selected based on questionnaires. The study was approved by the Health Research Ethics Committee of the University of North Sumatera Medical School.

We measured subjects' anthropometric data. Height was measured using a 2M microtoise (sensitivity 0.5 cm); weight was measured using *Camry*® scales (sensitivity 0.1 kg). Nutritional status was determined using the *2000 Centers for Disease Control-National Center for Health Statistic* (CDC-NCHS) standards. The WHO classified nutritional status to be normoweight for weight/height of 90 to 110%.[9] Subjects' BPs were measured at rest, with the cuff on the right arm at a 2-3 cm distance from the cubital fossa, in a sitting position with feet on the floor. Three measurements were made in intervals of 10 to 15 minutes, then averaged for both SBP and DBP. Lipid profiles were measured using the CardioCheck cholesterol test, with 97% sensitivity and 95% specificity. After subjects had fasted for 12 hours, lipid profile examinations were performed by pricking a finger using a lancet, removing blood with a capillary pipette, then inserting onto the test strip. After 3 minutes, the results for total cholesterol, high-density lipoprotein cholesterol (HDL-C), triglycerides, and LDL-C levels appeared on the screen.

Data were processed with *SPSS version 15.0* software. Mann-Whitney test was used to determine differences between SBPs, DBPs and lipid profiles (total cholesterol, triglycerides, and HDL-C) in adolescents with and without parental hypertension. Independent t-test was used to determine differences in LDL-C in adolescents with or without parental history of hypertension, with a 95% confidence interval (CI). Multivariate analysis with linear regression was used to examine the relationship in the variables measured. The significance level was set at $P<0.05$.

Results

Two hundred adolescents fulfilled the inclusion criteria, but only sixty-eight adolescents with and without parental history of hypertension participated. Characteristics and distribution of subjects are shown in **Table 1.** Mean age, weight and height, as well as gender distribution were similar in adolescents with hypertensive and normotensive parents. Blood pressure and lipid profiles were performed in both groups and are shown in the **Tables 2** and **Table 3. Table 2** shows that the systolic and diastolic blood pressures in adolescents with hypertensive and normortensive parents were not significantly different. **Table 3** shows that triglyceride and HDL-C levels were not significantly different in adolescents with hypertensive and normortensive parents, but the median total cholesterol level was significantly higher in adolescents with hypertensive parents ($P=0.001$). The mean LDL-C level was also

significantly higher in adolescents with hypertensive parents (P=0.001).

For variables with P<0.25 in bivariate analysis, we performed a multivariate linear regression analysis which revealed a correlation of moderate strength between parental history of hypertension and increased LDL-C in adolescents (**Table 4**).

Table 1. Characteristics of subjects

Characteristics	Adolescents with hypertensive parents (n=34)	Adolescents with normotensive parents (n=34)
Mean age (SD), years	15.9 (0.74)	15.9 (0.74)
Gender, n		
Male	19	14
Female	5	20
Mean height (SD), cm	158.7 (6.74)	158.1 (5.69)
Mean weight (SD), kg	48.8 (5.05)	50.8 (5.69)

Table 2. Blood pressure in adolescents with hypertensive and normotensive parents

Blood pressure, mmHg	Adolescents with hypertensive parents (n= 34)	Adolescents with normotensive parents (n= 34)	P value
Median SBP (min-max)	110 (93.3-123.3)	106.7 (96.7-123.3)	0.584[a]
Median DBP (min-max)	73.3 (66.7-83.3)	71.7 (63.3-80.0)	0.953

a: Mann-Whitney test; SBP=systolic blood pressure; DBP=diastolic blood pressuer

Table 3. Lipid profiles in adolescents with hypertensive and normotensive parents

Lipid profiles, mg/dL	Adolescents with hypertensive parents (n= 34)	Adolescents with normotensive parents (n= 34)	P value
Median total cholesterol level (min-max)	162.0 (158-170)	159.0 (150-170)	0.001[a]
Median triglyceride level (min-max)	70.0 (60-80)	70.0 (65-96)	0.808
Median HDL-C level (min-max)	45.0 (40-49)	45.0 (42-49)	0.504
Mean LDL-C level (SD)	103.5 (3.72)	99.1 (4.63)	0.001[b]

a: Mann-Whitney test; b: independent T-test

Table 4. Multivariate linear regression analysis

Step	Variable	Coefficient	Correlation coefficient	P value
Step1	Total cholesterol	- 0.006	- 0.056	0.801
	LDL-C	- 0.044	- 0.411	0.066
	constant	6.957		0.002
Step 2	LDL-C	- 0.049	- 0.459	< 0.001
	constant	6.496		

Discussion

We found that SBP and DBP in adolescents with parental hypertension was higher than in adolescents with normotensive parents, although there was no statistically significant difference. The results are consistent with the literature that children or adolescents with hypertensive parents had higher blood pressure than adolescents with normotensive parents.[10]

Evaluations for hypertension in adolescents should include observations on lifestyle and family history of hypertension.[10] However, family history of hypertension is a well-established risk factor, present in 45.2% of hypertensives and 31.4% of non-

hypertensives, a difference that was not statistically significant.[11] Some studies have shown an increased association with maternal hypertension and others with paternal hypertension. Other studies have found an increased familial association of other cardiovascular events, such as myocardial infarction and stroke.[12] Other factors that predispose adolescents to hypertension are obesity, stress, and salty food.[13]

According to the National Kidney Foundation, 90% of pediatric essential hypertension occurs in adolescense, and is rare in early childhood. The incidence of essential hypertension is always associated with increasing age.[14] A study of 132 children in Dallas found 67% of hypertension cases had renovascular disease and 23% had essential hypertension. The incidences of essential hypertension were 14% in 2-to-6-year-olds, 30% in 7-to-11-year-olds, and 35% in those above 11 years of age. This finding suggests that essential hypertension is more common when children begin to enter adolescence than in early childhood.[15]

Familial aggregation of BP levels has been well-established in cross-sectional studies in various societies and has been shown to be detectable in children at a very young age.[15] Elevated blood pressure in adolescents is almost always associated with families who have cardiovascular disease.[17] Parental history of hypertension was strongly associated with adolescent hypertension in both sexes, with odds ratio (OR)=13.32 (95%CI 2.25 to 78.94) and OR=11.35; (95%CI 1.42 to 90.21), for boys and girls, respectively.[15] Several important risk factors were cardiovascular abnormalities such as serum total cholesterol, LDL-C, smoking, diabetes mellitus and obesity.[18] Specific evaluation of essential hypertension should include assessing for the presence of risk factors such as hyperlipidemia and involvement of organs such as the heart and kidneys.[19]

A recommendation regarding a targeted approach to cholesterol screening for children from the *National Cholesterol Education Program* (NCEP) of the *National Heart, Lung, and Blood Institute* was published in 1992 and subsequently adopted by the AAP.[4] This approach recommends screening children with a family history of premature cardiovascular disease (CVD) or high blood cholesterol. They also recommend screening pediatric patients whose family history is unknown or those who have other risk factors for CVD such as obesity, hypertension or diabetes mellitus. The optimal screening program would identify children and adolescents with progressive atherosclerosis who are most at risk of CVD in adulthood.[4]

We found that total cholesterol and LDL-C were higher in adolescents with hypertensive parents than in those with normotensive parents. Multivariate analysis revealed an association between parental hypertension and high LDL-C in adolescents. These results are consistent with several previous studies which suggested that children and adolescents from families with a history of premature cardiovascular disease or hypercholesterolemia had increased LDL-C levels.[4]

The presence of a family history of premature CVD was noted to be associated with elevated LDL-C and lipoprotein (a) levels, as well as decreased HDL-C levels. A clinical diagnosis can usually be made by the observation of more extreme abnormalities of fasting lipoprotein levels in family members, combined with a positive family history of premature atherosclerotic cardiovascular disease and events.[20] A study of 1,034 children with familial hypercholesterolemia reported that LDL-C>3.5 mmol/L (>135 mg/dL) was predictive of hypercholesterolemia, with a 0.98 post-test probability, comparative unaffected family members.[21] Increased BP in adolescents with a family history of hypertension or dyslipidemia, along with high triglyceride and low HDL-C levels in the adolescents, may be indicative of development of essential hypertension in the adolescents.[22]

Data from the *Lipid Research Clinics* prevalence studies have shown that the concentration of serum lipids and lipoproteins increases during early childhood and reaches concentrations similar to those seen in young adults by approximately 2 years of age.[23] This knowledge is important when making recommendations regarding screening, because concentrations before 2 years of age may not reflect values in subsequent years of childhood or the adult values. A study compared data from the *National Health and Nutrition Examination Surveys* (NHANES) in 1966–1970 and 1988-1994 in children and adolescents aged 4 to 19 years and reported a decrease of mean total cholesterol concentration about 7 mg/dL. Data from the 1988-1994 NHANES for ages 4 to 19 years showed that the mean total cholesterol concentration was 165 mg/dL. Age-specific values for mean total

cholesterol concentration actually peaked at 171 mg/dL, at 9 to 11 years of age.[24] The values subsequently decreased during pubertal development and then increased thereafter. This has important implications for the timing of cholesterol screening and the cut-off points used, because lipid concentrations are age- and maturation-dependent.[25]

There are also differences in cholesterol and triglyceride concentrations in different ethnic groups. In the 1988–1994 NHANES, black children had higher HDL and lower triglyceride concentrations than children of both non-Hispanic white and Hispanic descent. In the Cardiovascular Health in Children Study in North Carolina of 8-to-10-year-olds, black children had the highest prevalence of total serum cholesterol concentration >200 mg/dL at 18.7%, compared with 11% in white children. The overall prevalence in all ethnic groups of a total cholesterol level of >200 mg/dL was 12.6%.[24] The Bogalusa Heart Study and Muscatine Study found approximately 70 to 75% of children had elevated levels of cholesterol which can predict the cholesterol levels in adolescents. In general, this approach found that as many as 35% of children and 46% of teens have high cholesterol levels, in those with a family history of CVD or increased cholesterol levels.[4]

Our study did not classify lipid profiles by gender or ethnicity. A limitation of this study was its small sample size and lack of parental blood pressure and lipid profile evaluations.

In conclusion, there are no SBP and DBP differences in adolescents with and without parental history of hypertension. However, total cholesterol and LDL-C levels are significantly higher in adolescents with hypertensive parents than those with normotensive parents.

Conflict of interest

None declared.

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