Lipid Profile Analysis in School Children

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Summary

Background: According to the World Health Organization, coronary atherosclerosis is the leading cause of death worldwide. The INTERHEART study demonstrated that dyslipidemia is one of the most important independent risk factors for AMI.

Objective: To evaluate the lipid profile and blood pressure of school children attending private (paid) and public/philanthropic (free) schools.

Methods: Blood samples from 343 children were tested and correlated with their lifestyle. Statistical analysis was carried out using the Student's t-test for independent samples to compare the means, and the chi-square test (c^2) to compare proportions. The significance level was set at 5%.

Results: Total cholesterol and its HDL and LDL fractions, as well as the Castelli Index I, were higher among private school students, with statistical significance for both genders, except for HDL in boys. Blood pressure was higher in the same group, but without reaching statistical significance. Twenty-three percent of private school students had total cholesterol > 190 mg/d, as compared to 4% of those attending public/philanthropic institutions. When the dietary and physical activity surveys were compared and correlated with the lipid profile, a clear association was found between daily physical activity and nutritional guidance among those of lower socioeconomic status.

Conclusion: This study demonstrated the positive correlation of total cholesterol and its LDL fraction with eating habits and more intense and regular physical activity, benefiting the most needy children, compared to those enrolled in private schools. (Arq Bras Cardiol 2007;89(2):65-70)

Key words: Lipids; dyslipidemias; child, adolescent; cardiovascular diseases.

Introduction

Dyslipidemia, hypertension, and obesity, in conjunction with poor eating habits and sedentariness, constitute ideal conditions for the development of heart disease[1]. These risk factors are not limited to adults - they are becoming increasingly frequent among children and adolescents[2-5]. The worldwide trend is to investigate and prevent, correcting risk factors as early as possible since it has been proven that atherosclerosis begins in childhood and could be delayed by early detection. Due to this fact, in many countries dietary concerns begin as early as two years of age[2]. According to the Bogalusa Heart Study[6-8], approximately 50% of all one-year-olds have atheromatous lesions in the aorta and, as of ten years of age, 100% of them have fatty streaks in the aorta and in the coronary bed that were correlated with serum LDL cholesterol levels. The PDAY multicenter study focusing 3000 individuals from 15 to 34 years of age suggested that the prevention of heart disease should begin with teenagers, or at least young adults, controlling adult heart disease risk factors[9].

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Some Brazilian studies showed the presence of a high percentage of dyslipidemia (38.5%) in children, as in the case of 109 children born of patients with early heart disease. Of these 109 children, 27.5% had higher than desirable total cholesterol levels, 19.3% had high LDL levels, 13.8% had low HDL levels, and 13% had higher-than-normal levels of triglycerides. No relationship was found here between family income and dyslipidemia[10]. Another study carried out in the city of Campinas (São Paulo State) on a sample of 1600 school children from 7 to 14 years of age showed a 35% prevalence of hypercholesterolemia, with greater incidence among girls[11]. Physical activity was correlated with total cholesterol levels in 799 caucasian children and adolescents and showed that hypercholesterolemia risk was three times greater among girls in the lowest quartile of physical activity as compared to those of the highest quartile, a fact that was not observed among the boys[12].

A survey featuring a sample consisting of 186 adolescents from 10 to 17 years of age in the municipality of Veranópolis (State of Rio Grande do Sul) showed that 12% of the boys and 22% of the girls had high cholesterol levels, and 11% of both genders had high blood pressure[13]. Such studies show the presence of dyslipidemia in brazilian children and, consequently, the need for better acquaintance with the local realities of this problem.

This study was designed to evaluate the lipid profile and blood pressure of first-grade children enrolled in public/philanthropic (free) and private (paid) schools, and how these children's socioeconomic status affects their lifestyle and, hence, their lipid levels.

Methods

Sample - We invited several schools of the city of Rio de Janeiro to participate in this study. Some schools declined the invitation and in some other cases the parents failed to give written authorization for their children to undergo blood tests. Of the total institutions invited to take part, one public school and four private schools declined the invitation. Our sample was limited to 400 children by the number of kits available, and the children were chosen at random from the schools that agreed to take part, but ensuring an equal number of students from each of the two different types of schools (public and private). This was achieved by allocating half of the kits to children enrolled in public schools and half to those enrolled in private schools. In each type of school, drawings were held in several classes to select the children who were to take part from among those whose parents had given written consent for blood tests.

The study sample was made up of 343 children from the schools that agreed to join this project and whose parents or primary caretakers provided written authorization for them to be tested. This total comprised 171 children from public/philanthropic schools and 172 from private schools – 173 girls and 170 boys – ages ranging from 5 to 16 (mean age 10 years).

Distribution of students among the schools was as follows: Eduardo Guimarães (private): 46 students; Eliezer Steimberg (private): 50 students; GIMK (private): 39 students; São Vicente de Paula (private): 37 students; Orfanato Frei Luiz (philanthropic): 50 students; Jose de Alencar (public): 45 students; Romão Duarte (philanthropic): 41 students; CIEP Tancredo Neves (public): 35 students.

Lipid levels were measured using capillary blood sample, allowing tests to be performed at the schools themselves – a less traumatic method, and one more readily accepted by the children. Triglyceride levels were not measured, since the children could not be required to fast for at least 12 hours. However, this fact did not hamper LDL measurement, which was performed using a specific kit (direct analysis). Capillary blood samples were drawn from the index finger of each student, and the lancing device with the material was introduced into the analyzer.

The testing device used was the Cholestech LDX system, made by the company of the same name (Hayward, California, USA). It consists of a portable analyzer, printer, accessories (lancets and capillary tubes), and an optics check cassette. This system was tested and approved by the Food and Drug Administration, and the variation coefficients (accuracy ≥ 95% in accordance with the laboratory measurements) of the results are consistent with the rates established by the National Cholesterol Education Program - USA[14].

Blood pressure was measured with a mercury sphygmomanometer (Baumanometer Latex Inflation Bag made by W. A. Baum Company Inc., Copiague, New York, USA) in both upper limbs after students had rested for 10 minutes in a seated position.

Students were asked to complete a questionnaire regarding their eating habits and physical activity. Whenever possible, parents were also asked to complete a questionnaire on the same topics plus questions regarding heart disease and hypertension.

Statistical analysis - Of the initial group of 400 school children, only 343 blood test results were considered of adequate quality for analysis. We then sought to compare mean plasma total cholesterol and its HDL and LDL fractions, as well as blood pressure, between genders, and between two types of schools.

The statistical analysis was carried out using the Student's t-test for independent samples to compare averages, and the chi-square ($\chi 2$) test to compare proportions. The significance level was set at 5%.

Results

The questionnaires showed that a greater number of private school students were engaged in regular physical activity, such as judo, swimming, ballet or tennis, at least three times a week (50.9% *vs* 18.5%). However, upon interviewing the students we found that this data was misleading since the most needy children – those studying in philanthropic institutions, most of whom did not know their parents or had no relationship with them, and those from public schools whose family income was lower than that of children studying in private schools – actually had more physical activity and on a more regular basis by means of the games they played (soccer, catch, hide-and-seek, hopscotch, and so on), as well as from their comings and goings, usually on foot. On the other hand, the physical activity of children from higher-income-bracket families was limited to the time spent playing sports, and their remaining spare time was usually spent at the computer, playing videogames, or watching television, in addition to which they were almost always transported by motor vehicles.

A similar situation was found regarding food. The first basic difference is that in philanthropic institutions and public schools, all of the meals and/or snacks provided are supervised by professional nutritionists. Another difference is that the children in philanthropic institutions eat only the meals provided by the institution and lack the means, for example, to eat at luncheonettes or snack bars. The same was true of many students enrolled in public schools who eat only the food provided by the school. The reality of children in private schools is quite different: there are no nutritionists providing guidance in regard to food. Private schools have canteens or snack bars, many of which are outsourced and therefore seek profit rather than nutrition. In addition, these children frequently eat at fast-food restaurants and in some cases fast food is the only type of meal they recognize.

As far as lipids are concerned, we considered a total cholesterol level of 190 mg/dl as the limit (recommended for youngsters up to 18 years of age at the time the study was initiated), higher therefore than the current level of 170 mg/dl considered desirable according to recommendations

of the III Brazilian Guidelines on Dyslipidemia and Guideline of Atherosclerosis of the Atherosclerosis Department of the Brazilian Society of Cardiology[9].

The difference in mean cholesterol levels between students of private schools (171.4 mg/dl) and their counterparts in public/philanthropic institutions (136.7 mg/dl) was statistically significant (p = 0,000000000000000034), and was true for both genders: 169.9 mg/dl (private) and 141.4 mg/dl (public) for males, with - p = 0,0000000000000000058; and 173.1 mg/dl (private) and 132.5 (public) for females, with p = 0,000000000000000087 (Figure 1).

The same situation was found with respect to the LDL cholesterol fraction, 101.9 mg/dl (SD = 30) in private school students, and 83 mg/dl (SD = 31.18) in public school students (p = 0.0011); 102.4 mg/dl *versus* 86 mg/dl (p = 0.00226) for male students, respectively; and 101.4 mg/dl *versus* 73.3 mg/dl (p = 0.00896) for female students, respectively.

The inverse was true for HDL fraction: 52.6 mg/dl (SD = 12) among private school students and 47 mg/dl (SD = 10.23) among public school students (p = 0.0000174); 53.3 mg/dl *versus* 44.9 mg/dl (p = 0.0000034) for female students and 51.9 mg/dl *versus* 49.9 mg/dl (p = 0.185) for male students, thus not statistically significant.

The Castelli Index I showed results identical to those of total cholesterol and LDL, i.e., lower in the public/philanthropic institutions in general and also among female students (3.44 for private schools and 3.06 for public schools), with p = 0.01981; and male students (3.44 and 3.01, respectively), with p = 0.00814 (Figure 2).

The most striking finding was the percentage of students with total cholesterol higher than 190 mg/dl: 23% among students enrolled in private schools and only 4% among

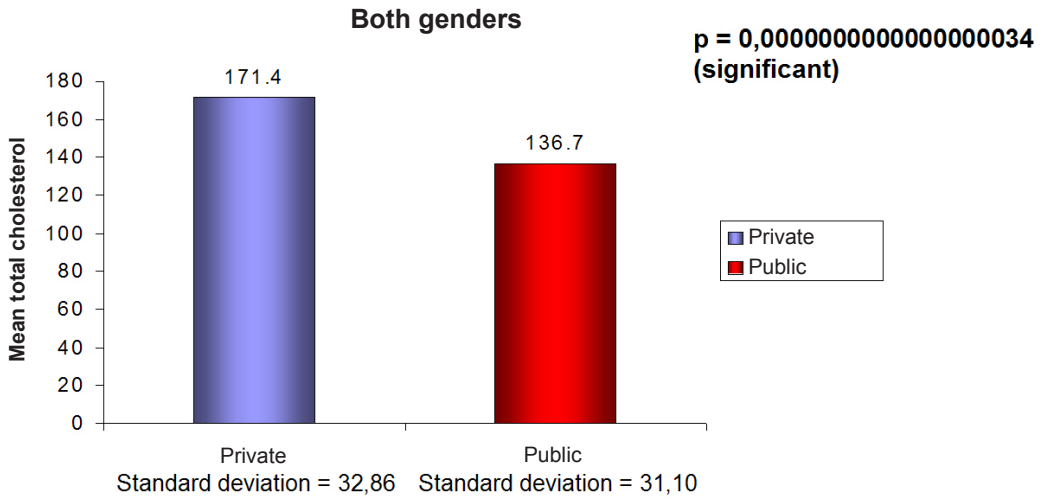

Fig. 1 - Mean total cholesterol by school category for both genders.

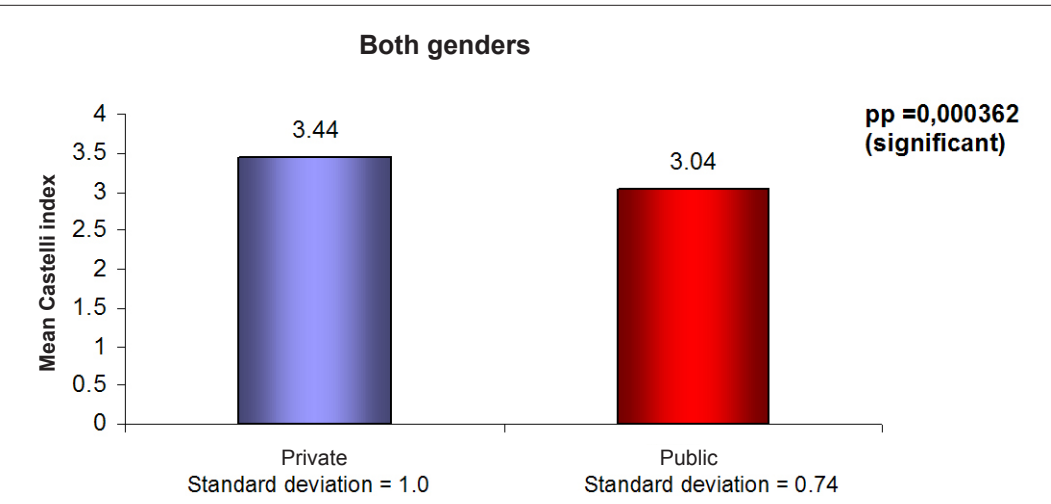

Fig. 2 - Mean Castelli I index by school for both genders.

students of public/philanthropic institutions, showing a high level of statistical significance (Figure 3).

When we consider the maximum cholesterol level of 170 mg/dl, as recommended by the III Brazilian Guidelines on Dyslipidemia and Guideline of Atherosclerosis of the Atherosclerosis Department of the Brazilian Society of Cardiology[9], we find that the mean values for three of the four private schools are already higher than the recommended level, while in the public/philanthropic institutions the highest mean was 147 mg/dl. In like manner, 49.2% of the private school students exceed the recommended level compared with only 14% of the students of public/philanthropic institutions.

In regard to blood pressure, the maximum percentage of higher-than-desired levels (119 x 81 mm Hg)[15] was 12.8% in one sole school, but the mean value was on the order of 4.5%. No statistically significant difference was found between the two groups of schools or among age brackets: mean high blood pressure readings was 6.1% in private schools and 2.4% in public schools (p = 0.14). The same result was found when we compared children below 10 years of age (1.6%) with those 10 years old or older (5.5%) (p = 0.14) (Figure 4).

Discussion

The quite compelling measurement results seem to correlate with the students' lifestyles, analyzed based on replies to the questionnaires and on the selective interviews. In many cases, the students from philanthropic institutions have no relatives who visit them, and all the food they receive is subject to guidance by nutritionists. In the public schools, we found many children whose main or only meal is that provided by the school, which is also supervised by nutritionists. On the other hand, in the private schools there is no concern regarding the type of food offered to students. Many of these schools have outsourced – and therefore profit-oriented – canteens or snack bars that sell all types of food without any concern for the quality of food offered to these students. In addition, the greater purchasing power of private school students allows them to eat at fast-food chains and other places that serve food containing trans fats.

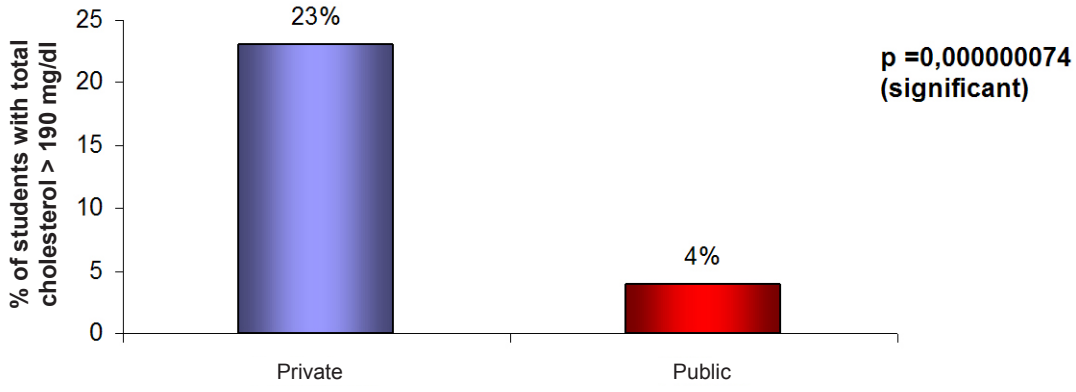

Fig. 3 - *Percentage of students with total cholesterol ≥ 190mg/dl by school category.*

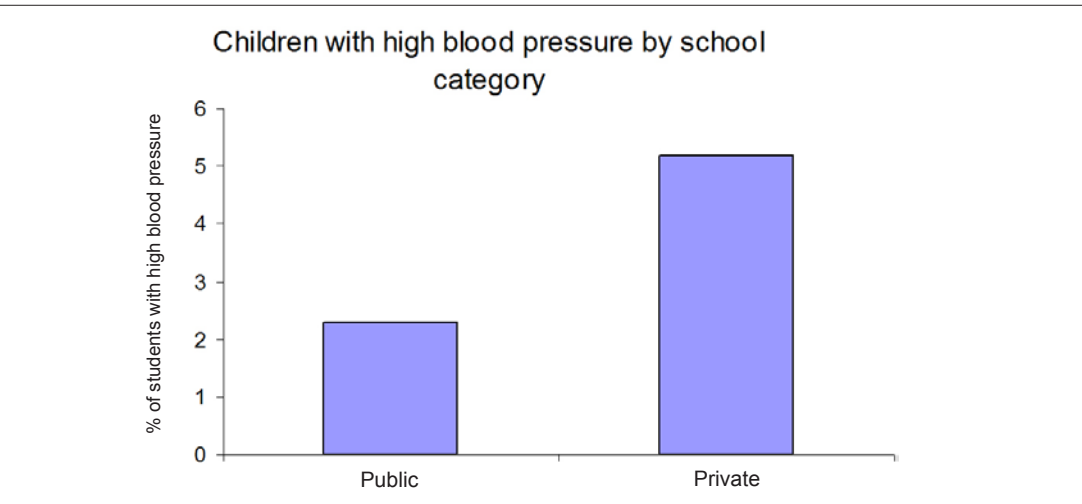

Fig. 4 - *Percentage of children with high BP by school category.*

As far as physical activity is concerned, we found that, theoretically, private school students exercised more regularly, but when compared to the type of games that children of public/philanthropic institutions play (hide and seek, soccer, races, etc) and the distances they walk daily, the children enrolled in the public/philanthropic schools actually get more intense and constant physical activity.

Comparing these results with those found by Giuliano in a survey of 1053 individuals between 7 and 18 years of age in Florianópolis (State of Santa Catarina), we found that they are similar in regard to an increased number of children with high cholesterol levels, and that this is more frequently found in private schools, in children under 10 years of age, in girls, and in african-brazilians[16]. Our findings were also consistent with those obtained by Grillo in school children from low-income families who had low cholesterol, high triglyceride and LDL levels, and HDL 17.9% lower than the recommended level[17].

Studies carried out in Finland had already shown that the food intake during childhood and adolescence can have a significant influence in adulthood and that the exposure to risk factors in childhood (such as high LDL cholesterol, low HDL cholesterol, obesity and hypertension) is inversely related to decreased carotid artery elasticity, which portends the same change in adulthood.

The *Special Turku Coronary Risk Factor Intervention Project for Children* (STRIP) study randomized 1062 seven-month-old children, 522 to the control group, and 540 to the intervention group that received a low-saturated-fat, low-cholesterol diet. At 11 years of age, 179 children of the intervention group and 190 of the control group underwent brachial artery vasodilatory response measurements. The results show that a low-saturated-fat diet introduced in infancy and maintained throughout the first decade of life is associated with enhanced endothelial function only among male children. The effect was explained in part by the diet-induced reduction in cholesterol levels[20,21].

All these data show an association of modern society's living habits as early as during infancy with cardiovascular diseases in adulthood and the urgent need to change these habits at the most tender age possible. These data were fundamental in heightening interest in the lipid profile of school children and how the children's socioeconomic status (represented by individuals enrolled in private as compared to public/philanthropic schools) affects their lifestyle and, consequently, lipid levels.

Limitations - The data presented in this paper show only the reality of the participating schools and cannot be extrapolated to the population as a whole. The study sample did not cover more distant neighborhoods or municipalities, or even locations further from the coast, which might somehow have an influence on the school children's eating habits. It was also impossible to establish any correlation between family history and the data obtained due to the lack of any family records of abandoned children. Another limiting factor was the scant time available for evaluation of the children (only during recesses), which made it difficult to gauge other parameters such as weight and body mass index (BMI). Finally, due to the difficulty of carrying out a 12-hour dietary recall survey with these children and thus draw a correlation with the lipid profile, although the data was well defined, it could not be statistically evaluated.

Conclusions

In regard to the lipid profile, mean total cholesterol was higher in private school students than in students enrolled in the public school system for both genders. The same was found in regard to LDL cholesterol and the Castelli I Index. As far as HDL is concerned, the inverse was true – lower in the public schools in general and among girls. The number of school children with total cholesterol over 170 mg/dl was much greater in the private than in the public schools.

The overall number of children with high blood pressure was small – greater in the private schools, but not statistically significant.

The correlation of serum lipid levels with eating habits and physical activity, which also showed quite different profiles among the groups, leads us to assume that there is a cause and effect relationship between more physical activity plus better nutritional guidance and the lipid profile, this not being the case only in regard to HDL cholesterol.

These data suggest the need for wider ranging studies of a regional or possibly national nature that could confirm the results presented herein and thus serve as a basis for planning means of improving our children's health.

Given all these reasons, it seems obvious that school children, parents, and teachers must be provided with clear explanations regarding cardiovascular disease risk factors, and the importance of more recommendable eating habits and regular practice of physical activity as primary prevention measures.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

There were no external funding sources for this study.

Study Association

This study is not associated with any graduation program.

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