Original Article

**Serum Lipids in School Kids and Adolescents from Florianópolis, SC, Brazil - Healthy Floripa 2040 Study**

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**Objective**

To determine the distribution of serum lipids in children and adolescents of Florianopolis, Santa Catarina State, Brazil. To determine the association between undesirable levels for total cholesterol (>170 mg/dL) and others coronary heart disease risks factors.

**Methods**

A questionnaire, physical examination and blood analyses were collected from randomized sample from school kids aged range from 7 to 18 years old.

**Results**

1,053 students participated, aged between 7 and 18 years old. They presented a total cholesterol mean of 162±28 mg/dl, triglyceride mean of 93±47 mg/dl, HDL-cholesterol mean of 53±10 mg/dl, LDL-cholesterol mean of 92±24 mg/dl and non-HDL cholesterol mean of 109±26 mg/dl. The TC/HDL and LDL/HDL mean rates were, respectively, 3.1±0.6 and 1.8±0.5. Findings showed that private school children, 10 years old or less, girls and black children had higher lipids values. Overall findings suggest that the best logistic regression model which explained abnormal total cholesterol levels included: obesity, stroke and heart attack familial history, feminine gender, age of 10 years old or less and overweight body image determined on inspection.

**Conclusion**

In comparison to international literature, our results, showed intermediated total cholesterol, lower LDL-cholesterol and non-HDL-cholesterol and higher HDL-cholesterol. Therefore, primary prevention programs are needed to be carrying out, especially among overweight children and adolescents so to prevent ischemic heart disease as adulthood.

**Key words**

child, adolescent, lipids, atherosclerosis, risk factors

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Atherogenesis is a process that starts in the early stages of life. A great number of anatomicopathological studies already showed the presence of initial lesions of atherosclerosis on the arterial wall of individuals in their first year of life. Atherosclerotic disease (AD) is one of the main causes of morbidity and mortality among adults all over the world, with a trend of in affecting younger people in developing countries. In Latin America, this disease is responsible for about 20 to 35% from total mortality, being one of the main causes of expenses in Health in most countries in the region. In the 1980s, approximately 50% of deaths due to coronary disease in Brazilian capitals occurred before 65 years of age.

Observational studies show that cholesterol levels in children are directly associated to the prevalence of coronary disease in adults from the same region. Such observation is in accordance with the tracking phenomenon, states that which there is a strong trend that children remain in the same cholesterol percentiles until adulthood. Besides, this data, the risk factors for atherosclerotic disease tend to have during (clustering effect) in individuals, by the process of growth and development.

The prevalence of dyslipidemias in childhood and adolescence varies between 24 and 33% with a progressive increase of those rates along the years in some countries (especially in those that suffered occidentalization of habits) and a decrease especially in countries that instituted prevention programs. Given the important causal relation between LDL and atherosclerosis, demonstrated in recent clinical assays, and the precociousness with which atherosclerotic vascular lesions settle, it is important to understand the lipidic profile of children and adolescents, so to planning preventive health actions.

In the present study, the distribution of serum concentrations of total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides, non-HDL fraction, and CT/HDL and LDL/HDL cholesterol relationships was determined in children and adolescents from Florianópolis (SC) schools, as well as the associations between lipids and other atherosclerosis risk factors.

**Methods**

A random sample of infants and adolescents enrolled in public and private schools from Florianópolis, SC, was analyzed.

The sample was calculated by using the EPI-INFO program, version 6.04B (CDC, Atlanta, USA and WHO, Geneva, Switzerland - 1997), based on a population estimated in 71,000 school children.
in the year 2001, taking for granted a sampling error of 3.5% and taking a 10% reference prevalence rate for the least prevailing risk factor (hypertension) and a confidence interval of 95%. A sample of 570 pupils resulted from that. For the purpose of stratification (age ranges from 7 to 10 years old, from 11 to 14 years old and from 15 to 18 years old), there was an increase of 36%, which reached to a total of 775 infants.

Private and public schools of Florianópolis were listed and then assorted, regarding to the proportion of enrolled pupils in each group. From the schools, two classes per school from each group were assorted, amounting about 180 children per institution, in addition of two substitute classes per group and per school. According to data from Secretaria Municipal de Educação (Municipal Education Secretariat), 97% of infants and adolescents between 7 and 18 years old were enrolled and studying.

An extensively, structured, previously validated questionnaire was used, regarding biological and social variables, which characterized the sample and identified atherosclerotic disease risks. The variables shown in this study emphasize lipidic associations. Physical exam consisted in weighing, height measurement, two blood pressure measurements with a 30-minute interval and a 3rd measurement if values were higher than percentile 95 for age and sex. Triceps and subscapular skinfolds and abdominal and pelvic perimeters were also measured. From those data, body mass index (BMI = weight/height²) and triceps-to-subscapular and waist-to-hip abdominal/pelvic rates were calculated.

Serum lipids were analyzed with blood collected in schools, with no fasting samples, and transported under refrigeration to the laboratory. Total cholesterol and triglycerides were determined by using an enzymatic method (SHOD-PAP, Merck®) and HDL-cholesterol directly determined, after precipitation of other lipoproteins29. LDL-cholesterol was calculated by employing the formula of Friedewald27, Criteria defined by III Diretrizes Brasileiras Sobre Dislipidemias e Diretriz de Prevenção da Aterosclerose da Sociedade Brasileira de Cardiologia (3rd Brazilian Guidelines on Dyslipidemias and Guideline for the Prevention of Atherosclerosis of Brazilian Cardiology Association)29 were used as abnormality criteria for lipids and lipoproteins, the Study from Navarra29, for total cholesterol/HDL and LDL/HDL rates, and Bogalusa Study29, for non-HDL. Values of lipids or their relations that were considered non normal values, were classified as non-desirable.

For the purpose of families economic classification, the Critério de Classificação Econômica Brasil (Brazil Economic Classification Criterion), from Associação Brasileira de Pesquisas de Mercado (ABIPME)31, was used.

Continuous variables were introduced as means and standard deviation, and percentages. For the comparison among means the t-test of Student and ANOVA (for more than two groups) were used, which is considered as statistically significant if p<0.05. The description of variables was carried out with EPI-INFO 6.04 B software and Microsoft Excel® 2002 software.

The association between total cholesterol and previously determined variables was determined through a theoretical model, by using the χ² test with significance level (α) of 5%. Continuous variables were categorized to allow for bivariate and multivariate analysis. Logistic regression was carried out to assess the association between hypercholesterolemia (total cholesterol >170 mg/dL) and factors as overweight or obesity, sedentary lifestyle, diet, abdominal obesity, educational level of parents and social class, by using the SPSS® program, version10.0.5, Chicago, USA.

After completion of data collection of the whole sample the schools were again visited for a new measurement of blood pressure in children who showed values higher than percentile 95 for age, sex and height in the first exam, and all parents and responsible people were contacted when inconsistent and incomplete data were detected in the questionnaires. After that stage, new telephone interviews were carried out from a sample of 5% of pupils, in order to certify on the fidelity of data. At that verification, no significant difference was detected.

Informed consent and protocol were submitted and approved by the Comitê de Ética em Pesquisa com Seres Humanos (Ethics Committee in Research with Human Beings) da Federal University from Santa Catarina.

Results

One thousand, two hundred and twenty-two (1,222) individuals were invited to participate in the study, and 1,053 of them agreed on participating in. The analyzed sample represented 1.5% from the total of individuals from Florianópolis within the age range from 7 to 18 years old.

From the 1,053 participating children and teenagers, 620 (59%) were female. The scholar distribution in age groups was: a) 7 to 10 years old: 28.4%; b) 11 to 14 years old: 37.8%; c) 15 to 18 years old: 33.8%.

Distribution regarding the type of school was among 706 (67%) individuals, in public schools and 347 (33%), in private schools. Concerning the socioeconomic class, there was a prevalence of class C pupils (35%). The average concentration of serum lipids and other indexes in this sample are displayed in table I.

Table I shows the main lipid comparisons between genders and between the two types of education institution attended by the scholars.

Female individuals showed higher concentrations of total cholesterol and LDL-cholesterol, and those who attended private schools showed higher levels of cholesterol, triglycerides and HDL-cholesterol. Lipidic distribution per age range is displayed in table III. A trend to higher levels is observed up to 10 years of age and a decrease of cholesterol, triglycerides, non-HDL-cholesterol and HDL-cholesterol from that age. There is a similar phenomenon concerning TC/HDL and LDL/HDL relations.

<table>
<thead>
<tr>
<th>Lipids and relations</th>
<th>mean±SD</th>
<th>CI 95%</th>
<th>P95</th>
<th>P5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mg/dL)</td>
<td>(mg/dL)</td>
<td>(mg/dL)</td>
<td>(mg/dL)</td>
</tr>
<tr>
<td>Total Cholesterol</td>
<td>162±28</td>
<td>160 - 164</td>
<td>214</td>
<td>-</td>
</tr>
<tr>
<td>HDL-cholesterol</td>
<td>53±10</td>
<td>52 - 54</td>
<td>-38</td>
<td>-</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>93±47</td>
<td>108 - 111</td>
<td>183</td>
<td>-</td>
</tr>
<tr>
<td>LDL-Cholesterol</td>
<td>89±24</td>
<td>89 - 92</td>
<td>133</td>
<td>-</td>
</tr>
<tr>
<td>Non-HDL Cholesterol</td>
<td>109±26</td>
<td>108 - 111</td>
<td>196</td>
<td>-</td>
</tr>
<tr>
<td>TC/HDL</td>
<td>3.1±0.6</td>
<td>-</td>
<td>4.2</td>
<td>-</td>
</tr>
<tr>
<td>LDL/HDL</td>
<td>1.8±0.5</td>
<td>-</td>
<td>2.6</td>
<td>-</td>
</tr>
</tbody>
</table>

P95: percentile 95; P5: percentile 5.
Figure 1, shows level distributions of lipids and lipoproteins found in the sample, classified as non-desirable from cardiovascular risk point of view. It is observed that, depending on the type of lipid, the non-desirable level rate may reach up to 22%, in the case of triglycerides. The relations between total cholesterol/HDL and LDL/HDL are presented in undesirable levels in 27% and 18% of pupils, respectively.

Logistic regression using of all theoretical model pre-defined variables, was carried out in a non-conditional way. Such model was significant (Hosner-Lemeshow test with p=0.16). Confusion variables were excluded to increase model consistency, so to arrive to a model that explains the highest number of cases studied.

When correlation total cholesterol to other analyzed variables, the model that was best adjusted (table IV), in which family history of early acute myocardial infarction, mother’s educational level, social class, physical activity, color of skin, and waist-to-hip ratio, regarded as confusion factors, were excluded. Such model explained 64.1% of studied cases, with maximum verisimilitude test of 0.828.

Regarding to cases resulting in desirable levels (TC <170 mg/dL), the model was able to support 95.5% of the cases.

Discussion

The present study determined serum lipid distribution in a representative sample of school children and teenagers from Florianópolis, as well as the association of high total cholesterol with other variables. It is necessary to emphasize that more than 95% of children and teenagers from Florianópolis were regularly enrolled in schools, which made such sample very representative of the city universe this age group.

Serum lipid and lipoprotein levels suffer deep changes during growth and development, with two expressive increase stages in their levels, up to the 2nd year of life and during sexual maturation. There is also an expressive increase of LDL-cholesterol in puberty, especially among white boys. The means of total cholesterol per age range in this sample are similar to data from national and international studies. Compared to Brazilian data, Florianópolis shows higher values than those from Belo Horizonte, especially among children older than 10 years old.

Few data are found in the literature for LDL-C means (often shown as medians, as in Bogalusa Study or non-determined as in that from 26 countries). Compared to Belo Horizonte study, pupils from Florianópolis showed lower values of that lipoprotein, especially among 10 yo children. Concerning HDL-cholesterol, the values from this sample were intermediate between Belo Horizonte and the meta-analysis from 26 countries, showing a prevalence of higher values among children older than 14 years old.

The comparison of triglyceride concentration was impaired, when compared to because non fasting samples were collected in Belo Horizonte. Data from Florianópolis showed higher triglyceride values, especially among children and teenagers.
By observing the means of lipoproteins and considering their distribution among different age ranges, children and teenagers in this sample showed a more favorable lipidic profile, except to triglycerides. So, the lipidic profile of this sample is similar to that from 26-country meta-analysis children 43, which also included populations with low prevalence of cardiovascular disease.

Important national and international epidemiological studies on lipid distribution among children and teenagers show high levels of all lipoproteins and lipids among female sex individuals, regardless of age or color of the skin24,35. In this work, we have verify the same difference, except to triglycerides, higher levestered among boys, which was also evidenced in Belo Horizonte study21.

American data show that low income social classes show higher levels of serum lipids, which is a fact explained due to higher rates of sedentary lifestyle and overweight or obesity36,37. Similarly this study, higher levels of serum lipids were found in private schools, especially due to increase of TC and HDL-cholesterol. Higher lipids and lipoproteins levels in private schools were also verified in other Brazilian cities21,22,38,39. That may be due to by the fact that in Brazil there are more overweight or obese children in higher classes, and mostly studying in private schools.

Perhaps in Brazil, middle-class has been suffering the same process experienced by the American middle-class in the 1960s, in which the higher income was reflected in a calorie and saturated fat “richer” diet. Currently in the United States of America (USA), that trend reversed, as people holds better and easy access to health information, which means, higher income classes do more exercise, eat less, smoke less and have lower mortality rates caused by cardiovascular disease36,38,40,41.

Studies all over the world have demonstrated that the average of total cholesterol is in proportion with to coronary disease prevalence in the studied region. Such data reinforce the preoccupation on reducing the population average levels of cholesterol, a decrease attempting in the frequency of atherosclerosis complications4,10. By comparing mortality rates due to atherosclerosis complications and the respective means of total cholesterol among children from 4 Brazilian cities, and data from the sample [Bento Gonçalves (227/100,000, 167 mg/dL) (22), Campinas (223/100,000, 160 mg/dL) (39), Belo Horizonte (222/100,000, 158 mg/dL) (21) and Florianópolis (224/100,000, 162 mg/dL) (42)], it is observed that, like other countries, in Brazil the two indexes are close related.

Therefore criteria to determine whether a child or teenagers has risk to develop coronary disease in adulthood is been established. In Brazil, Sociedade Brasileira de Cardiologia – Brazilian Cardiology Association - (SBC)23, like the USA, at the National Education Program on Cholesterol43, defined desirable levels of lipids for children and teenagers, as well as limiprote and altered values. Results obtained are uncomparable with the literature available, as there is a great variety of criteria defining ideal lipid levels in different age ranges. However, by using SBC criteria, approximately one fifth of scholars from Florianópolis showed one or more lipidic fractions on levels defined as undesirable.

The relation between dyslipidemia and other cardiovascular risk factors in childhood aims at establishing rules for the lipid dosage in that age range. Currently, the recommendation for cholesterol measurement is limited to infants with family history of hypercholesterolemia or early coronary disease43. Moreover, such practice show low sensitivity to detect higher risk individuals, as demonstrated in international and national studies23. For that reason, the study of associations of lipidic levels with other independent variables has clinical importance to detect dyslipidemic infants and adolescents in a more efficient and less costly way.

Multivariate analysis in this sample defined a model to forecast the presence of hypercholesterolemia (total cholesterol >170 mg/dL). It included the following variables: obesity, family history of death due to acute myocardial infarction (AMI), gender, family history of cerebrovascular accident (CVA), age under 10 years old and overweight body image, defined by the physician. Such model explained 64% of the studied cases, especially concerning desirable level cases (cases with total cholesterol <170 mg/dL were explained in 95.5%).

In national studies, such as Bento Gonçalves23 and Belo Horizonte21, higher values of total cholesterol are verified in private schools, unlike most of American studies, in which lower social class infants are more obese and sedentary38,40,41. In this study there was a similar behavior in the analysis of total cholesterol association with social class. A strong association between the two risk factors in bivariate analysis was verified, which was probably explained by the higher prevalence of overweight in high social class (A1, A2, B1 and B2) children. Such association is unlikely when obesity is isolated. That phenomenon is very complex and may be related with educational, cultural and genetic factors. Further studies are needed a greater to determine the real cause for such difference.

It is known that physical activity is one of determinant factors for the decrease of coronary disease risk in adults40. The effect of physical activity on childhood dyslipidemia is far from being completely understood, as there are conflicting data on whether the effect is mediated by weight control induced by energetic waste and if the response is the same between boys45 and girls45-52. In this work, a relation between physical activity and dyslipidemia was only evidenced in bivariate analysis, and its effect disappeared when the multivariate analysis was carried out, in accordance with agreeing on some international studies45,50.

The cause of that behavior seems to come from the difficulty of measurement of physical activity at childhood. Another possibility is that infants are often sent to regular physical activity practice and are supervised for weight excess treatment, being obesity clearly associated to dyslipidemia in childhood45,50. Although the direct relation between sedentary lifestyle and dyslipidemia was not proven, stimulation to physical activity is maybe one of the most important measures for the prevention of coronary disease since infancy, as it may promote weight control, which is hard to achieve with only caloric restriction diet40,53.

In Florianópolis sample, overweight was the most strongly risk factor to associated dyslipidemia, which was in accordance with most studies54,60, but not similar to Gerber51 findings, in Bento Gonçalves. The association between body mass and dyslipidemia has many metabolic causes: resistance to insulin, hyperinsulinemia, hyperglycemia, increase of cholesterol ester-transferer protein, secreted by adipocytes, among others51. Body weight control is an efficient measure in dyslipidemia control, with decrease of LDL-C and increase of HDL-C, especially among girls55.

There was a strong association between obesity diagnosed at
inspection (body image of obesity and overweight diagnosed by the physician) and body mass index in the sample studied. Suggesting a populational level clinical importance, as the impression of excess of weight may guide the need for the collection of children lipidic profile. According to some studies in children, which have demonstrated that abdominal obesity can help predict dyslipidemia, the struggle against children obesity must be faced as a Public Health priority, as it brings many short- and long-term consequences, both physical and emotional ones, which makes it more and more necessary, as a progressive increase of its prevalence has been seen all over the world. Acquisition of healthy life habits during childhood (weight control, physical activity and proper nutrient and caloric diet specific for the age) increases the chances for the maintenance of such habits in adult life, and probably reduces the risk of early chronic-degenerative diseases.  

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There is much controversy on how family history (FH) determines dyslipidemia risk. Such interaction seems to be multifactor, in which cultural, genetic and environmental factors are inter-connected. Such behavior differs according to the age and sex of the children and parents. A negative association between history of death due to coronary disease and total cholesterol was found. Besides memory bias, occasional change of life habits in families with positive history of death can be explained due to cardiovascular disease, may be tools preventing to disease.  

As opposed to international studies, no association between dyslipidemia and early coronary event history was found. Such data reinforce somehow the findings in the work from Bento Gonçalves, where 2/3 of infants with dyslipidemia did not have an early history of coronary disease, and from Bogalusa Study, which demonstrated the possibility of the currently used criterion not having the sensitivity and the specificity to forecast dyslipidemia in infants.

Whenever bivariate and multivariate analyses of certain associations were confronted, it is evidenced that the masking effect is some variables may accurred when there analyzed separately from the set of involved factors. That occurred in this study, especially with the variables of physical activity, waist-to-hip ratio, mother’s educational level, skin color and social class. After determination of the independent effect of each variable, it was noted that variables as obesity, family history and female were, in fact, determinants of previously found associations.

Concluding, this epidemiological inquiry, with a representative sample of scholar infants and adolescents from Florianópolis, established the distribution of lipid and lipoprotein concentrations and their associations with other variables of cardiovascular risk. Overweight revealed as being the strongest associated risk factor to hypercholesterolemia. Measures aiming the body weight control in childhood and adolescence may have an important impact on cardiovascular diseases in the future of that population.

References

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