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ORIGINAL ARTICLE

Evaluation of Lipid Profile in Adolescents

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Abstract

Background: Atherosclerosis is a chronic, multifactorial and insidious disease that can begin in childhood and adolescence, and whose major consequences appear during adulthood. Serum levels of lipoproteins, such as LDL-c, total cholesterol (TC), HDL-c, and non-HDL-c can be used as a screening method for disease diagnosis. In Brazil, few studies have correlated the serum levels of those lipoproteins with age.

Objective: To evaluate the serum concentrations of TC, LDL-c, HDL-c, VLDL-c, non-HDL-c and triglycerides (TG) of adolescents aged 10 to 19 years in the municipality of Araucária, Paraná state.

Methods: Cross-sectional retrospective study, collecting the following data from 600 adolescents: age, sex and serum levels of TC, LDL-c, HDL-c and TG from June to December 2016. Data were analyzed using the SPSS software 2.0, with Mann-Whitney U test and Spearman coefficient of correlation to identify statistical significance ($p < 0.05$).

Results: The female sex showed higher serum levels of TC, TG and LDL-c than the male sex. The HDL-c levels were identical in both sexes, with 48% of desirable values and 52% of low values. This study identified a strong correlation between the lipids and association with the age group of 10 to 14 years.

Conclusion: Non-HDL-c showed stronger correlation with the other lipids (TG, LDL-c and TC) as compared to LDL-c, suggesting that non-HDL-c can be used as an effective complementary diagnostic method to assess the risks for atherosclerosis in adolescents. (Int J Cardiovasc Sci. 2018;31(4)367-373)

Keywords: Dyslipidemias/epidemiology; Adolescent; Lipoproteins; Hypercholesterolemia/epidemiology.

Introduction

Cardiovascular diseases (CVD) are the major cause of death of men and women worldwide.[1] In Brazil, according to the last 2013 Ministry of Health survey, of a total of 201,062,789 inhabitants, 678,556 of the deaths were related to the circulatory system.[2]

The risk factors for CVD are classified as modifiable and nonmodifiable. Some of the modifiable risk factors are sedentary lifestyle, smoking, obesity and dyslipidemia.[2] Some nonmodifiable risk factors are family history of CVD, age, sex and ethnicity.[3] Dyslipidemia has a great influence on the development of CVD, since an inadequate diet increases the concentration of low-density lipoprotein cholesterol (LDL-c) in blood vessels.[4,5] Such lipoproteins can adhere to the intimal layer of arteries, causing the formation of atheromatous plaques that lead to atherosclerosis.[6] This atherosclerotic process begins in childhood, before clinical symptoms can be perceived.[7] In the aorta, fatty streaks begin at the age of 3 years, while in the coronary arteries, 5 to 10 years later.[8] Over time, such fatty streaks form fatty plaques that can rupture, leading to different ischemic processes, such as acute myocardial infarction and stroke.[9]

The lipid profile is a panel of blood tests to assess the serum concentrations of lipoproteins, such as total cholesterol (TC), high-density lipoprotein cholesterol (HDL-c), LDL-c, very-low-density lipoprotein cholesterol (VLDL-c), non-HDL-c, and triglycerides (TG).[10]

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Knowing that dyslipidemia is associated with CVD, its diagnosis in adolescence can reduce the chances of future complications, because a change in lifestyle to healthier habits can be the best prevention.[11,12]

This study was aimed at assessing the lipid profile of adolescents of the municipality of Araucária, Paraná state. It collected data of 600 adolescents aged 10 to 19 years and compared them to those of studies conducted in other regions of Brazil.

Methods

This study was approved by the Ethics Committee in Research of the *Instituto Paranaense de Otorrinolaringologia* and is registered under the number 65932917.0.0000.5529, according to the Resolution 466/12 of the National Board of Health of the Ministry of Health, which regulates research with human beings. The results of 600 lipid profiles were collected from the Araucária Municipal Laboratory, which had been approved by the local coordinator, so that the study could begin even before approval by the Ethics Committee in Research.

This is a cross-sectional, retrospective study with convenience sampling of the lipid profile of 600 adolescents aged 10 to 19 years, through systematic random sampling, from July to December 2016. Tests with TG levels greater than 400 mg/dL were excluded. The samples were collected 5-mL tubes containing serum separating gel and particles to activate clotting, and were tested by enzymatic photometric assay (Abbott Architect c8000), using the direct precipitation method for HDL-c quantitation (Ultra HDL). To calculate VLDL-c, the TG level was divided by 5, and to calculate LDL-c, the Friedewald formula was used. The collected data were organized in Excel 2007 sheets and stratified as TC, LDL-c, HDL-c, non-HDL-c (sum of the lipoproteins without HDL), VLDL-c and TG, in addition to age and sex of the adolescents, being identified by codes and organized in tables and graphs.

Statistical analysis

The descriptive statistical analysis included percentage and median with respective interquartile range (IQR). Continuous variables were expressed as median and IQR, because they had no normal distribution, while categorical variables were expressed as percentages. Normality was assessed by use of the Kolmogorov-Smirnov test. The statistical analysis comprised Mann-Whitney U test and Spearman coefficient of correlation (S), using the SPSS software 2.0. The adopted significance level was 5% of probability and 95% confidence interval, and all tests were two-tailed.

Results

The lipid profiles of 600 adolescents aged 10 to 19 years from the Araucária Municipal Laboratory were assessed. Of the 600 adolescents, 322 (54%) were of the female sex and 278 (46%) were of the male sex. Table 1 shows the analyzed data, which, in 1.83% (n = 11) of the adolescents, it is suggested familial hypercholesterolemia.[10] Tables 2, 3 and 4 show the correlations between the lipids, where 1 means perfect positive correlation, that is, when one variable increases, the other increases at the same intensity, and -1 means perfect negative correlation, that is, when one variable increases, the other decreases at the same intensity.

When comparing between sexes, the female sex had a higher TC than that of the male sex (Figure 1A). Regarding non-HDL-c, the female sex had a median of 109 and IQR of 40.25, while the male sex had a median of 101 and IQR of 32.25, with no significant difference between them. In addition, in the non-stratified sample, positive correlations of non-HDL-c were found with TG, TC and VLDL-c as compared to LDL-c, and fewer negative correlations with HDL-c (Table 2).

In adolescents aged 10 to 14 years, more positive correlations of non-HDL-c with TG, TC and VLDL-c were found as compared to LDL-c, and some negative correlations of LDL-c, TC and non-HDL-c with age (Table 3). When comparing between sexes, only TG showed a difference (Figure 1B). Regarding sexes, in adolescents aged 15 to 19 years, the correlations showed the same trend of the other age group (Table 4), and the comparisons between sexes achieving significance for the LDL-c (Figure 1C) and TC (Figure 1D), while the other lipids showed no statistically significant variation.

Discussion

The study by Silva et al.[11] has reported desirable values of TC of 50%, similar to those found in the present study (49%), but different from the 37% reported by Araki et al.[13] This difference was observed in a study conducted in the city of Aracaju, Sergipe state, which has found a higher TC value in the female sex as compared to that in the male sex, a result that corroborates that found

Table 1 - Lipid profile of adolescents aged 10 to 19 years

GENERAL TABLE (n = 600; male = 278; female = 322)				
Values	**(%) n**	**(%) n**	**(%) n**	**(%) n**
Lipids	TC	HDL-c	LDL-c	TG
Desired	(72) 432	(48) 288	(77) 465	(70) 421
Increased	(28) 168	----------	(23)135	(30) 179
Low	----------	(52) 312	----------	----------
STRATIFICATION BETWEEN SEXES				
Values	**(%) n**	**(%) n**	**(%) n**	**(%) n**
FEMALE 54% n = 322				
Lipids	TC	HDL-c	LDL-c	TG
Desired	(69) 221	(48) 155	(75) 243	(67) 216
Increased	(31) 101	----------	(25) 79	(33) 106
Low	----------	(52) 167	----------	----------
MALE 46% n = 278				
Lipids	TC	HDL-c	LDL-c	TG
Desired	(76) 211	(48) 133	(80) 222	(74) 205
Increased	(24) 67	----------	(20) 56	(26) 73
Low	----------	(52) 145	----------	----------

Values according to the 2017 Brazilian Guideline on Dyslipidemia and Atherosclerosis Prevention.[10] TC: total cholesterol; HDL-c: high-density lipoprotein cholesterol; LDL-c: low-density lipoprotein cholesterol; TG: triglycerides; n: absolute number of individuals.

in this study and in the specialized literature. Similar results have also been reported by Silva et al.[14] in a study conducted in the city of Janeiro, and by Araki et al.[15] in a study conducted in the city of Aracaju, Sergipe state, and by Kruger et al.[16] in a study conducted in the municipality of Mamboré, Paraná state.[16]

The serum levels of TG in adolescents aged 10 to 14 years were higher in the female sex, which has been also reported by Silva et al.[14] and Kruger et al.[16]

Regarding LDL-c, the findings are similar to those reported by Araki et al.[13] and by Seki et al.,[17] who have shown a strong positive correlation between LDL-c and non-HDL-c, between LDL-c and TC, and between non-HDL-c and TC. Some negative correlations have been reported involving non-HDL-c and HDL-c, coinciding with the same studies. In addition, our study showed that as the adolescents from the 10-to-14-year-old group aged, their serum levels of LDL-c, TC and non-HDL-c decreased.

Several studies have shown that non-HDL-c is one of the best indicators of the atherosclerotic risk in children and adolescents,[18-20] because it is more strongly associated with lesions in the abdominal aorta and coronary arteries than the other lipids are,[20-22] in addition to being associated with metabolic diseases.[23] The stronger correlations of non-HDL-c with the other lipids (TG, LDL-c and TC) found in this study as compared to those of LDL-c are in accordance with the literature, and the National Heart, Lung and Blood Institute (NHLBI) has already included reference values for non-HDL-c, recommending it for screening during childhood.[24] In adults, non-HDL-c is a better predictor of CVD than LDL-c is.[25,26]

In this study, among the adolescents aged 10 to 19 years, changes in HDL-c levels were observed in 52% of the sample, similarly to the study by Silva et al.[11] conducted in the municipality of Barras, Piauí state, which reported changes in HDL-c levels in 70% of the sample, and the

Table 2 - Correlations of the lipid variables in adolescents aged 10 to 19 years (n = 600)

		Age	TG	LDL-c	HDL-c	TC	VLDL-c	Non-HDL-c
Age	S	1	0.004	-0.079	-0.010	-0.071	0.004	-0.080
TG	S	0.004	1	0.292**	-0.232**	0.396**	0.999**	0.493**
LDL-c	S	-0.079	0.292**	1	0.024	0.896**	0.289**	0.935**
HDL-c	S	-0.010	-0.232**	0.024	1	0.282**	-0.230**	-0.032
TC	S	-0.071	0.396**	0.896**	0.282**	1	0.394**	0.934**
VLDL-c	S	0.004	0.999**	0.289**	-0.230**	0.394**	1	0.490**
Non-HDL-c	S	-0.080	0.493**	0.935**	-0.032	0.934**	0.490**	1

*TC: total cholesterol; HDL-c: high-density lipoprotein cholesterol; LDL-c: low-density lipoprotein cholesterol; TG: triglycerides; Non-HDL-c: sum of the lipoproteins without HDL-c; S: Spearman correlation. * p < 0.05; ** p < 0.001.*

Table 3 - Correlations of the lipid variables in adolescents aged 10 to 14 years (n = 339)

		Age	TG	LDL-c	HDL-c	TC	VLDL-c	Non-HDL-c
Age	S	1	-0.056	-0.140**	-0.079	-0.138*	-0.056	-0.136*
TG	S	-0.056	1	0.262**	-0.300**	0.337**	0.999**	0.457**
LDL-c	S	-0.140**	0.262**	1	0.039	0.912**	0.257**	0.949**
HDL-c	S	-0.079	-0.300**	0.039	1	0.282**	-0.298**	-0.053
TC	S	-0.138*	0.337**	0.912**	0.282**	1	0.333**	0.926**
VLDL-c	S	-0.056	0.999**	0.257**	-0.298**	0.333**	1	0.452**
Non-HDL-c	S	-0.136*	0.457**	0.949**	-0.053	0.926**	0.452**	1

*TC: total cholesterol; HDL-c: high-density lipoprotein cholesterol; LDL-c: low-density lipoprotein cholesterol; TG: triglycerides; Non-HDL-c: sum of the lipoproteins without HDL-c; S: Spearman correlation. * p < 0.05; ** p < 0.001.*

Table 4 - Correlations of the lipid variables in adolescents aged 15 to 19 years (n = 261)

		Age	TG	LDL-c	HDL-c	TC	VLDL-c	Non-HDL-c
Age	S	1	0.063	0.064	0.071	0.086	0.065	0.054
TG	S	0.063	1	0.328**	-0.143*	0.468**	0.999**	0.537**
LDL-c	S	0.064	0.328**	1	0.006	0.878**	0.329**	0.919**
HDL-c	S	0.071	-0.143*	0.006	1	0.281**	-0.142*	-0.007
TC	S	0.086	0.468**	0.878**	0.281**	1	0.468**	0.944**
VLDL-c	S	0.065	0.999**	0.329**	-0.142*	0.468**	1	0.538**
Non-HDL-c	S	0.054	0.537**	0.919**	-0.007	0.944**	0.538**	1

*TC: total cholesterol; HDL-c: high-density lipoprotein cholesterol; LDL-c: low-density lipoprotein cholesterol; TG: triglycerides; Non-HDL-c: sum of the lipoproteins without HDL-c; S: Spearman correlation. * p < 0.05; ** p < 0.001.*

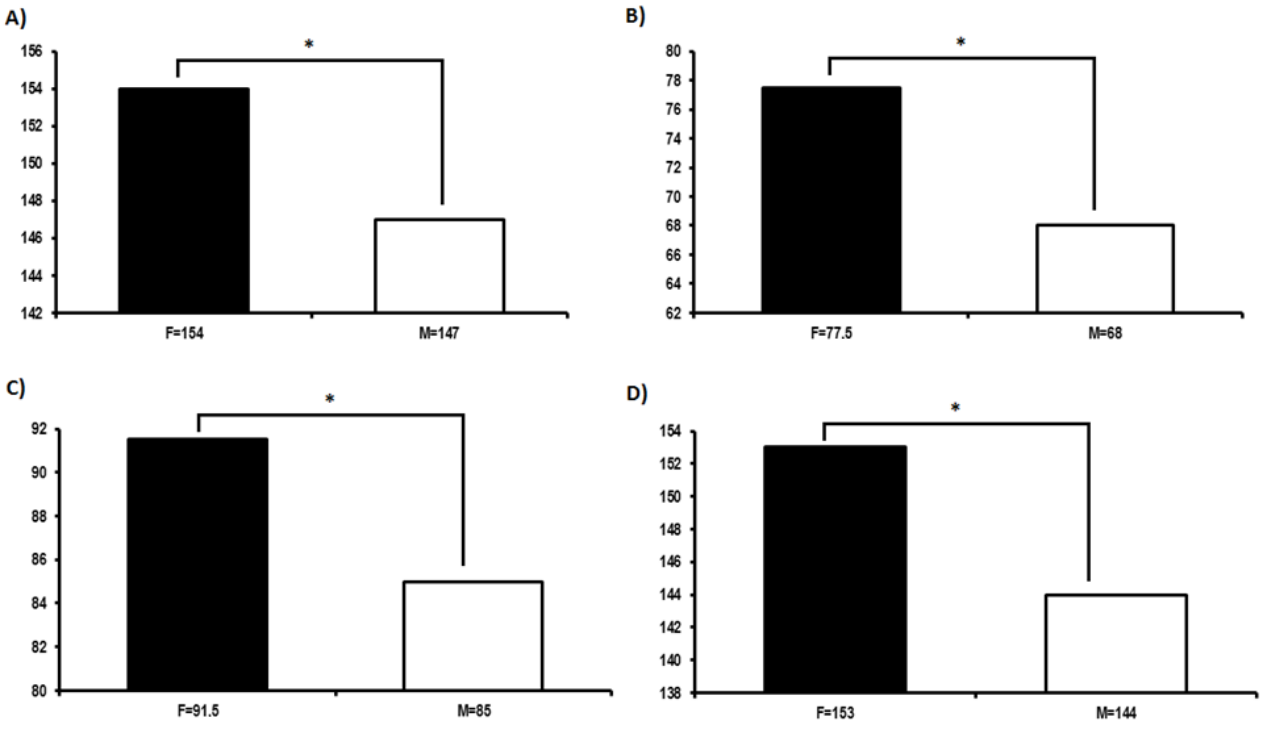

Figure 1 - Assessment of the lipid profile of adolescents for the serum levels of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-c) and triglycerides (TG). F: female; M: male. A) TC; difference between F (IQR = 44) and M (IQR = 36.25), p: 0.043* (Mann-Whitney U test); B) TG; difference between F (IQR = 37.5) and M (IQR = 42), p: 0.017* (Mann-Whitney U test); C) LDL; difference between F (IQR = 31.75) and M (IQR = 29.5), p: 0.049* (Mann-Whitney U test); D) TC; difference between F (IQR = 43.5) and M (IQR = 32), p: 0.026* (Mann-Whitney U test).

study by Ramos et al.[25] conducted in the municipality of Campina Grande, Paraíba state, which reported changes in HDL-c levels in 80.6% of the sample. Some different results have also been reported. Silva et al.[14] have reported 22% of changed HDL-c values in a study conducted in the city of Rio de Janeiro, while Seki et al.,[28] in a study conducted in Londrina, Paraná state, have reported 14.3% of changed HDL-c values. Such differences reported in the literature might be related to genetic, environmental and local factors, because the studies are from distinct geographic, ethnical and cultural regions. It is worth noting that this study has limitations, because it is a retrospective study with convenience sampling of a specific population, whose samples had already been collected.

Conclusion

This study's results showed that, of the 600 adolescents, 30% had some type of hypercholesterolemia and more than 50% had some type of dyslipidemia. Regarding the adolescents with dyslipidemia, the female sex had the highest prevalence, suggesting that preventive measures should be taken considering sex.

In conclusion, the serum level of non-HDL-c showed stronger correlation with the other lipids (TG, LDL-c and TC) as compared to LDL-c. This suggests that non-HDL-c can be used as an effective complementary diagnostic method to assess the risks for atherosclerosis in adolescents of this study's age group. Non-HDL-c can be an important biomarker, and should be included in the lipid profile, as already used for adults.

Author contributions

Conception and design of the research: Cunha EDBB, Fagundes RP; Acquisition of data: Fagundes RP; Analysis and interpretation of the data: Cunha EDBB; Statistical analysis: Cunha EDBB, Scalabrin EE; Writing of the manuscript: Cunha EDBB; Critical revision of the manuscript for intellectual content: Herai RH.

Potential Conflict of Interest

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

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Study Association

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Ethics approval and consent to participate

This study was approved by the Ethics Committee of the *Instituto Paranaense de Otorrinolaringologia* under the protocol number 65932917.0.0000.5529. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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