Original Article

# Lipid Profile of Schoolchildren from Recife, PE

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## Abstract

**Background:** **The occurrence of dyslipidemia is increasing in pediatric populations. Altered lipid profiles are related to a higher incidence of hypertension and atherosclerotic disease.**

**Objective:** **To evaluate the extent of dyslipidemia and investigate its association with overweight and abdominal obesity in adolescent students from Recife, Brazil.**

**Methods:** **Personal data, socioeconomic level, anthropometric measurements and lipid profile of 470 adolescents, aged 10 to 14 years, of both sexes, students at the Public School system in the city of Recife, state of Pernambuco, Brazil, were obtained. The statistical analysis was carried out using the Epi-info 6.04 and SPSS 13.0 software. The level of significance was set at 5%.**

**Results:** **The majority of the population was dyslipidemic (63.8%; 95%CI: 59.3 - 68.2), with hypoalphalipoproteinemia being the most prevalent dyslipidemia (56%; 95%CI: 51.3 - 60.5). Adolescents who were overweight or who had abdominal obesity presented higher levels of triglycerides and lower levels of HDL-cholesterol ($p < 0.05$). Levels of total cholesterol and fractions were not different between sexes.**

**Conclusion:** **A high incidence of unfavorable lipid profile was shown in this series, demonstrating the necessity to measure the lipid profile as early as this age range. Healthy lifestyle measures should be encouraged in this population. (Arq Bras Cardiol 2010; 95(5): 606-613)**

**Keywords:** **Dyslipidemias/epidemiology; hypertension; obesity, abdominal; adolescent; life style; Recife; Brazil.**

## Introduction

Dyslipidemia is a clinical condition characterized by abnormal levels of lipids or lipoproteins in blood that is determined by genetic and environmental factors. Evidence has demonstrated that high levels of total cholesterol (TC), LDL-cholesterol (LDL-c) and triglycerides (TG), as well as decreased levels of HDL-cholesterol (HDL-c) are related to a higher incidence of hypertension and atherosclerotic disease[1].

Atherogenesis starts with the formation of fatty streaks, which are the precursors of atheroma plaques. They start to appear at the aorta as early as three years of age and, in adolescence, they start to affect the coronaries, subsequently progressing at the other phases of the life cycle[2]. The disease has a slow and silent evolution and the clinical manifestations in adult life result in several morbid conditions that affect the circulatory system, which, in turn, culminate in high mortality rates[3]. The literature has demonstrated the start of atherosclerosis as early as in childhood due to the increase in plasma cholesterol levels, which can be potentiated throughout life by obesity and other factors, such as family history, physical inactivity, inadequate diet and arterial hypertension[4].

Updated publications in our country indicate an increase in the occurrence of dyslipidemia in children and adolescents[5-7]. The prevalence in this age group varies worldwide between 2.9% and 33%, with a progressive increase along the years[8,9].

Dyslipidemia is often secondary to childhood obesity and there is a positive association between the incidence of obesity and dyslipidemia in children and adolescents[3]. Studies have shown the association between the anthropometric parameters that classify overweight and abdominal obesity and the altered lipid profile in this group[10,11].

Considering the increasing number of children and adolescents at risk for the development of cardiovascular diseases and considering the few population–based studies on the prevalence of dyslipidemia in Brazilian adolescents, it is of utmost importance to perform studies to assess the problem at this age range.

Therefore, the present study aimed at assessing the extent of dyslipidemia and investigating the association of the lipid profile with overweight and abdominal obesity in adolescent students from the Public School system in the city of Recife, state of Pernambuco, Brazil.

## Methods

An observational, cross-sectional study was carried out in 31 public elementary schools, which belong to the Public

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School system of the city of Recife, state of Pernambuco, from October to December 2007. The population consisted of schoolchildren aged 10 to 14 years, of both sexes, regularly attending these schools in the year 2007.

The sample size was determined based on the dyslipidemia prevalence data of a similar study carried out in Camaragibe, state of Pernambuco, Brazil[12]. The type of dyslipidemia with the lowest percentage (hypertriglyceridemia) was used to calculate the sample size. Therefore, considering a prevalence of 15%, with an acceptable margin of error of 5%, reliability of 5% and a population larger than 9,000 schoolchildren, the sample size was established as 196 students. As the process of sample selection was the polyphase type, of which sample units were the school (1$^{st}$ conglomerate) and the school year (2$^{nd}$ conglomerate), the sample "n" was adjusted by the effect of the study design, using a factor of correction of 2.1, totaling a minimum number of 412 adolescents . To correct eventual losses, 15% was added to this number, totaling a sample of around 470 students.

The following students were excluded from the study: those with a referred personal history of pathologies (diabetes mellitus type II, hypothyroidism, nephrotic syndrome, chronic renal failure, liver disease, Cushing syndrome, anorexia nervosa and bulimia) or referred use of medications (anti-hypertensive drugs, corticoids, steroids, isotretinoin, protease inhibitors) that could affect the lipid profile.

The information on personal data, socioeconomic level, anthropometric data and blood samples from the participants were obtained at the same time, at the schools and the data were entered in specific formularies.

For the biochemical measurements of TC, LDL-c, HDL-c and TG, approximately 5 ml of blood were collected from each student, after a 12-14-hour fast, in Vacutainer tubes. The tubes were stored in Styrofoam boxes containing recyclable ice were sealed and transported for the sample processing. The serum was separated from the red blood cells by centrifuging the samples at 3,000 rpm for 10 minutes at 4$^o$ C up to 2 hours after the venipuncture. The sera was placed in microtubes and stored at -20$^o$ C for subsequent lipid fraction measurement. The material was analyzed in a laboratory of clinical analysis and the serum levels of TC, HDL-c and TG were determined by enzymatic methods (Roche Diagnostics) and the LDL-c levels were estimated using Friedewald's formula: LDL-c = CT - (HDL + TG/5)[13].

The criteria used to determine abnormal levels of lipids and lipoproteins were those established by the I Brazilian Guideline for Atherosclerosis Prevention in Childhood and Adolescence[9] (I DPAIA). The cutoffs were established as: TC ≥ 150mg/dl (borderline) and TC ≥ 170mg/dl (increased); LDL-c ≥ 100 mg/dl (borderline) and LDL-c ≥ 130 mg/dl (increased); HDL-c < 45 mg/dl (not desirable); TG ≥ 100 mg/dl (borderline) and TG ≥ 130 mg/dl (increased). The diagnosis of dyslipidemia was based on altered or increased values. The individual was considered dyslipidemic when he or she presented at least one altered result.

The anthropometric assessment included weight, height and waist circumference measurement of the adolescents and the mean values were used in the study. To maintain the consistency of the data, measurements that contained differences higher than 100 g for weight, 0.5 cm for height and 0.3 cm for waist circumference were disregarded. Body weight was obtained using a Plenna-MEA-03140™ digital electronic scale, with a maximum capacity of 150 kg and a precision of 100 g. Height was measured used a Stanley™ measuring tape with millimeter grading, precision of 1 mm and accuracy of 0.5 cm, according to the norms established by Lohman et al[14]. The waist circumference (WC) was measured at the midpoint between the last costal arch and the iliac crest, with a flexible and inextensible measuring tape, without compressing the tissues[15].

The diagnosis of overweight was based on the body mass index (BMI), according to the values indicated by Cole et al[16], adjusted for age and sex. The diagnosis of abdominal obesity was carried out by assessing the WC and the WC(cm)/height (cm) ratio (WhtR). The cutoff used for the classification of the WC was the one recommended by Taylor et al[15], which defines abdominal obesity as WC ≥ 80$^{th}$ percentile, adjusted for age and sex.

Regarding the WHtR, the cutoffs used were the ones recommended by Li et al[17], and the value ≥ 0.5 was used as the cutoff to define the abdominal obesity.

The socioeconomic classification of the families followed the "Criteria for the Economic Classification of Brazil", established by the Brazilian Association of Anthropology and the Brazilian Association of Research Companies[18]. This instrument uses a scale of points, obtained by adding the points attributed to the ownership of domestic appliances and the degree of schooling of the head of the household, which divides the population in economic classes A1, A2, B1, B2, C1, C2, D and E, in a decreasing order, respectively starting with the one with the highest socioeconomic status.

The construction of the database and the statistical analysis were carried out using the Epi-info release 6.04 and SPSS release 13.0 software. The data were entered in duplicate and verified using VALIDATE, a module of the Epi-info Software release 6.04, to check the consistency and validation of the data.

The continuous variables were tested regarding the normality of distribution using the Kolmogorov-Smirnov test; the neperian logarithm was used to convert the ones that did not present a normal distribution, which were then tested again regarding the normality. After this transformation, only TG and age did not present a non-Gaussian distribution, of which data were described as medians and interquartile interval. The data of variables with normal distribution were expressed as means and standard deviations and as geometric means and respective confidence intervals, for the variables that presented a normal distribution only after the log-transformation. When describing the proportions, the binomial distribution was approximated to the normal distribution by the 95% confidence interval. The correlation assessment was carried out using Pearson's correlation test, as at least one of the variables involved presented a Gaussian distribution. The variables with normal distribution had their means compared by the Student's *t* test and the Mann Whitney U test was used for those that did not meet the criteria of normality or homoscedasticity. The level of significance was set at 5% for the rejection of the null hypothesis.

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The study was submitted to and approved by the Research Ethics Committee of Instituto Materno Infantil de Pernambuco (Registration# CEP/IMIP 1.024/07). All adolescents that participated in the study were previously informed on the objective of the research, as well as the methods to be employed. All parents or tutors in charge of the adolescents participating in the study signed the Free and Informed Consent Form.

## Results

Of the 470 blood samples, a LDL-c and three TC measurements were lost due to technical problems at the analysis of the fractions, whereas three data concerning weight, 11 concerning height and 13 concerning waist circumference were disregarded, as there were inconsistencies between the two performed measurements.

The age median was 11 years (CI: 10 - 12 years) and there were no differences between the sexes. Table 1 shows the characterization of the studied sample. Among the adolescents included in the study, most were females (55.3%; 95%CI: 50.7 - 59.9; $p < 0.05$). Regarding the socioeconomic class, there was a predominance of students from social class $C_2$ (43.6%; 95%CI: 38.5 - 48.9).

Considering as dyslipidemic the adolescent with alteration in at least one lipid profile fraction, most of the participants (63.8%) were considered as having the pathology (95%CI: 59.3 - 68.2; $p < 0.05$).

The prevalence of alterations in the different lipid profile measurements are shown in Table 2. There was a low frequency of LDL-c increase. On the other hand, a higher prevalence was observed for HDL-c alteration and hypoalphalipoproteinemia was the most frequent dyslipidemia.

When the occurrence of simultaneous dyslipidemias was analyzed, it was observed that the most frequently observed combination was TG+HDL-c decrease (12.1%) (Table 3). Figure 1 shows the correlation charts between different lipid fractions. Significant correlations ($p < 0.01$) were observed among all analyzed variables; however, the best correlation was observed between the TG and HLD-c values (r= - 0.38).

Table 4 shows the comparisons of lipids and lipoproteins between the sexes and the presence or not of overweight and abdominal obesity.

The levels of the lipid profile as a whole did not differ regarding sex ($p \geq 0.05$) and individuals with overweight, according to the BMI, showed higher levels of TG and lower levels of HDL-c. A similar fact was observed among students with abdominal obesity, according to the WC indicator. According to the WHtR indicator, the adolescents with abdominal obesity presented, in addition to higher TG and lower HDL-c levels, higher levels of LHL-c. The TC levels were the only ones that did not differ in relation to this parameter.

## Discussion

In Brazil, studies on the prevalence of lipid alterations in the pediatric age range are still scarce. The results obtained in the present study are important, as they demonstrate that dyslipidemia is part of a disturbing reality and must be investigated among the adolescent population of the country.

Additionally, the lack of standardization in the sampling and the methodology, mainly regarding the definition of reference intervals, impairs the comparison of this epidemiological phenomenon in the different states of the country. Many studies use cutoffs recommended by the III Brazilian Guideline on Dyslipidemias[19] (III DBSD), which use the values established by the National Cholesterol Education Program for children and adolescents from the United States[20]. This fact can induce potential biases, as it disregards differences in ethnicity, socioeconomic levels, dietary habits and the physical constitution of the Brazilian population[21]. Studies carried out in the city of São Paulo with children and adolescents identified reference intervals that were different from the values proposed by the III DBSD[22,23]. Thus, in 2005, the I Guideline for the Prevention of Atherosclerosis in Childhood and Adolescence (I DPAIA) proposed reference values for lipids and lipoproteins for Brazilian children and adolescents[9].

The prevalence of dyslipidemia found in the present study (63.8%) was quite high, which is an alarming fact. Gama et al[24], in an investigation carried out in children from the southeast

**Table 1 - Sample distribution according to the demographic and anthropometric variables of adolescents aged 10 to 14 years from Recife - 2007**

| | n | % | CI* |
|---|---|---|---|
| Sex | | | |
| Male | 210 | 44.7 | 40.1 – 49.3 |
| Female | 260 | 55.3 | 50.7 – 59.9 |
| AGE (years) | | | |
| 10 to 12 | 355 | 75.5 | 71.4 – 79.3 |
| > 12 | 115 | 24.5 | 20.6 – 28.6 |
| Socioeconomic class # | | | |
| $A_2$ | 1 | 0.3 | 0.0 – 1.5 |
| $B_1$ | 2 | 0.6 | 0.1 – 1.9 |
| $B_2$ | 33 | 8.9 | 6.2 – 12.3 |
| $C_1$ | 106 | 28.7 | 24.2 – 33.6 |
| $C_2$ | 161 | 43.6 | 38.5 – 48.9 |
| D | 64 | 17.3 | 13.6 – 21.6 |
| E | 2 | 0.6 | 0.1 – 1.9 |
| BMI‡ | | | |
| Overweight | 84 | 18.4 | 15.0 – 22.3 |
| WC§ | | | |
| Abdominal obesity | 59 | 12.9 | 10.0 – 16.3 |
| WHtR// | | | |
| Abdominal obesity | 49 | 10.9 | 8.2 – 14.2 |

**CI - 95% confidence interval; ‡ - body mass index; § - waist circumference; // - waist/height ratio. # According to criteria of economic classification of Brazil-2008, with a decreasing distribution: $A_1$ - highest socioeconomic class and E - lowest socioeconomic class.*

Table 2 - **Classification of the lipid profile according to the levels recommended by I Brazilian Guideline for Atherosclerosis Prevention in Infancy and Childhood, in adolescents aged 10 to 14 years from Recife - 2007**

| Lipid | Desirable | | | Borderline | | | Altered | | |
|---|---|---|---|---|---|---|---|---|---|
| | n | % | IC* | n | % | IC* | n | % | CI* |
| TC | 298 | 63.8 | 59.3 - 68.2 | 115 | 24.6 | 20.8 - 28.8 | 54 | 11.6 | 8.8 - 14.8 |
| LDL-c | 401 | 85.5 | 82.0 - 88.6 | 58 | 12.4 | 9.5 - 15.7 | 10 | 2.1 | 1.0 - 3.9 |
| HDL-c | 207 | 44.0 | 39.5 - 48.7 | - | - | - | 263 | 56.0 | 51.3 - 60.5 |
| TG | 304 | 64.7 | 60.2 - 69.0 | 95 | 20.2 | 16.7 - 24.1 | 71 | 15.1 | 12.0 - 18.6 |

** CI - 95% confidence interval; TC - Total Cholesterol; LDL-c- Low-density lipoprotein; HDL-c - High-density lipoprotein; TG - triglycerides.*

Table 3 - **Prevalence of mixed dyslipidemias according to the levels recommended by I Brazilian Guideline for Atherosclerosis Prevention in Infancy and Childhood, in adolescents aged 10 to 14 years from Recife - 2007**

| Mixed dyslipidemias | Altered | | |
|---|---|---|---|
| | n | % | CI* |
| TC + TG | 21 | 4.5 | 2.8 – 6.8 |
| TC + HDL-c | 23 | 4.9 | 3.1 – 7.3 |
| TG + HDL-c | 57 | 12.1 | 9.3 – 15.4 |
| TC + LDL-c | 10 | 2.1 | 1.0 – 3.9 |
| TG +LDL-c | 2 | 0.4 | 0.1 – 1.5 |
| HDL-c + LDL-c | 5 | 1.1 | 0.3 – 2.5 |
| TC + HDL-c + TG | 13 | 2.8 | 1.5 – 4.7 |
| TC + HDL-c + LDL-c + TG | 2 | 0.4 | 0.1 – 1.5 |

**CI - 95% confidence interval; TC - Total Cholesterol; TG - triglycerides; HDL-c - High-density lipoprotein; LDL-c - Low-density lipoprotein.*

region of the country using the cutoffs proposed by the DPAIA, reported a similar prevalence of dyslipidemia (68.4%).

Etiologically, dyslipidemias are classified as primary or secondary. The primary dyslipidemias have a genetic connotation and some of them only manifest only under the influence of environmental factors[25]. Among the prevalence of dyslipidemias, one must consider the homozygous familial hypercholesterolemias, which, albeit rare, are considered severe diseases[9]. Nevertheless, most dyslipidemias in children and adolescents are related to an inadequate lifestyle[25]. Therefore, The maintenance of a nutritionally adequate dietetic model, the control of body weight, the practice of physical exercises and the cessation of smoking are some of the recommendations related to changes in the lifestyle that help prevent alterations in the lipid levels, as well as establish healthy habits into the adult life[9,25].

The hypoalphalipoproteinemia was the main lipid alteration. This fact is noteworthy, as this is a young population and the HDL-c is an important protective factor against the development of chronic diseases, especially atherosclerosis[3]. Studies by Carvalho et al[2] and Grillo et al[26] with children and adolescents also demonstrated the occurrence of low HDL-c levels as the most frequent dyslipidemia at this age range. On the other hand, in the study by Gama et al[24], the increase in TC was the most prevalent dyslipidemia and the percentage of alteration in HDL-c levels was lower than the one observed in the present study (35.1% *vs* 56%).

In a study with a similar methodology, the frequency of increased TG levels was lower than the one found in the present study (3.5% *vs* 15%), whereas the LDL-c and TC levels were higher (18.6% *vs* 2.1%; 43.8% *vs* 11.6%, respectively)[24]. Other studies have also demonstrated higher percentages of increased TC levels, when considering values > 170 mg/dl[1,5,6]. On the other hand, our findings are in accordance with those by Scherr et al[7], who found a lower magnitude of hypercholesterolemia among schoolchildren from public/philanthropic schools (14%).

In the present study, the percentage of increased LDL-c levels was low. However, it is important to mention that there are subclasses of LDL, as one LDL is small and dense (LDL phenotype B) and another, which is larger. The LDL phenotype B, being smaller and denser, more easily cross the endothelial barrier and are more easily oxidable, which also makes them more atherogenic[27]. Thus, even in individuals with normal LDL-c levels, the lipid profile can be less favorable, given the proportion between the lipoprotein subclasses[28].

The occurrence of TG levels considered to be increased, together with decreased HDL-c levels, was the type of concomitant dyslipidemia more frequently observed among these adolescents. When the correlations between the lipid variables were analyzed, these fractions were the ones that presented the best correlation. This occurrence must be interpreted carefully, as the TG/HDL-c ratio is directly correlated with the LDL phenotype B in plasma, and thus, it can indicate a more atherogenic lipid profile[29].

The mean levels of lipids and lipoproteins obtained from the schoolchildren from the public schools in Recife are lower than the ones reported by other studies[1,5,6,10,30], except for the ones reported by Moura et al[5] and Franca and Alves[1] in which TG levels were slightly lower. Although the studies on the influence of the socioeconomic level on the lipid profile are not consensual, studies carried out in Brazil show lower means of TC, TG and LDL in the group from the lowest socioeconomic class[6,7,26]. Scherr et al[7] and Giuliano et al[6] compared the lipid profile of students from the public *vs*. private schools and observed, respectively, higher mean levels of TC and LDL-c and TC and TG among students from private schools. This might be explained by the fact that in Brazil, more overweight or obese children are still found in

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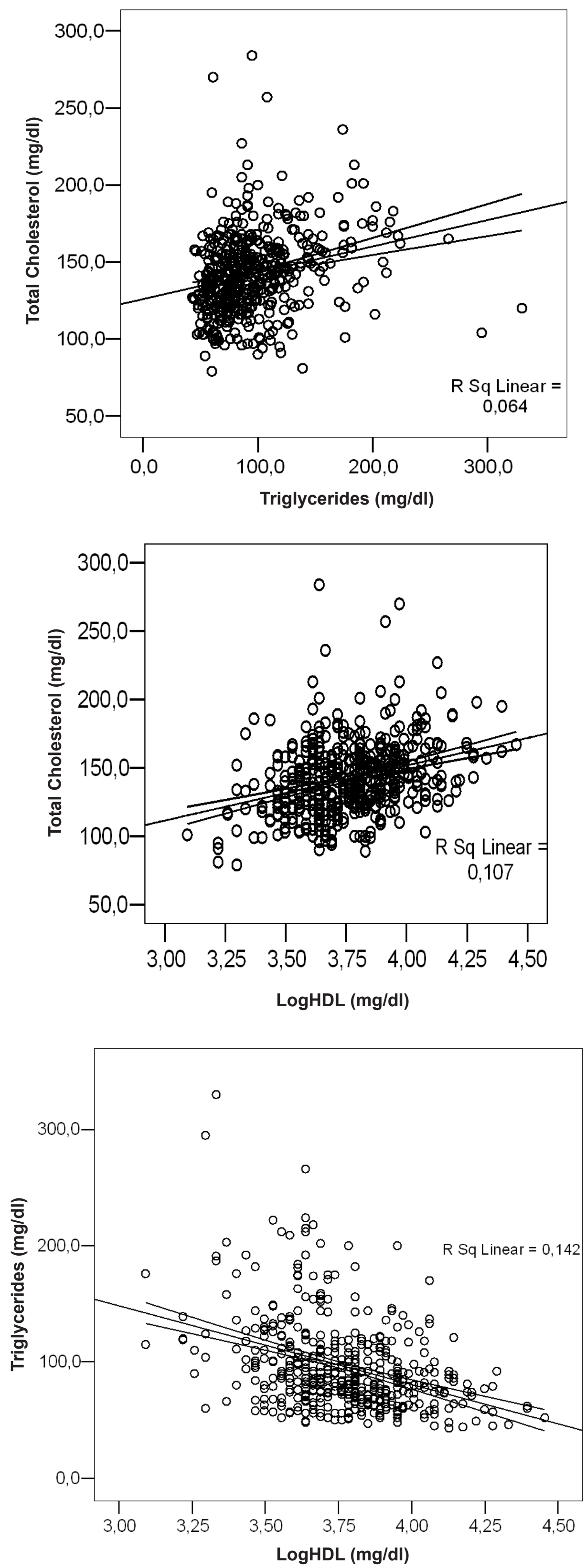


*Figure 1 - Correlations between the lipid variables in adolescents aged 10 to 14 years from Recife - 2007.*

**Table 4 - Lipid levels according to sex and different nutritional status classification parameters in adolescents aged 10 to 14 years from Recife - 2007**

| Variables | TC mg/dl | | | LDL-c mg/dl | | | HDL-c mg/dl | | | TG mg/dl | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Mean | ±SD | n | Geo Mean | CI* | n | Geo Mean | CI* | n | Median | IQ† |
| Sex | | | | | | | | | | | | |
| Male | 209 | 140 | ±27 | 209 | 74 | 72 - 77 | 210 | 43 | 42 - 44 | 210 | 84 | 68 - 106 |
| Female | 258 | 144 | ±27 | 260 | 77 | 74 - 80 | 260 | 43 | 42 - 45 | 260 | 90 | 73 - 118 |
| p¶ | | 0.10 | | | 0.10 | | | 0.10 | | | 0.05 | |
| BMI‡ (kg/m²) | | | | | | | | | | | | |
| No overweight | 370 | 141 | ±26 | 371 | 75 | 73 - 77 | 372 | 44 | 43 - 45 | 372 | 84 | 68 - 106 |
| With overweight | 83 | 146 | ±30 | 84 | 79 | 73 - 84 | 84 | 41 | 39 - 43 | 84 | 96 | 74 - 119 |
| p¶ | | 0.13 | | | 0.18 | | | 0.01 | | | 0.01 | |
| WC§ (cm) | | | | | | | | | | | | |
| No abdominal obesity | 396 | 142 | ±27 | 397 | 75 | 73 - 77 | 398 | 44 | 43 - 45 | 398 | 84 | 69 - 110 |
| With abdominal obesity | 58 | 145 | ±28 | 59 | 79 | 73 - 85 | 59 | 39 | 37 - 41 | 59 | 102 | 80 - 122 |
| p¶ | | 0.35 | | | 0.26 | | | < 0.01 | | | < 0.01 | |
| WHtR// | | | | | | | | | | | | |
| No abdominal obesity | 397 | 141 | ±27 | 398 | 75 | 73 - 77 | 399 | 44 | 43 - 45 | 399 | 84 | 69 - 110 |
| With abdominal obesity | 48 | 149 | ±30 | 49 | 82 | 75 - 90 | 49 | 39 | 37 - 41 | 49 | 102 | 78 - 122 |
| p¶ | | 0.06 | | | 0.03 | | | < 0.01 | | | < 0.01 | |

*"*95%CI - 95% confidence interval; †IQ - interquartile interval; TC - total cholesterol; LDL-c - low-density lipoprotein cholesterol; HDL-c - high-density lipoprotein cholesterol; TG - triglycerides;* **‡** *- body mass index;* **§** *- waist circumference; // / - waist circumference/height; Student's t test for parametric data and Mann-Whitney U Test for non-parametric data.*

the upper socioeconomic classes, who mostly attend private schools[6]. When we compared the findings of the present study with those observed among students from public schools only, we obtained higher TG and lower HDL-c levels, whereas the TC and LDL-c levels were similar[7,26].

The fact that the mean values of the lipid fractions were lower than those observed in studies carried out with Brazilian schoolchildren[6,10,30] might be due to the fact that the students from public schools present a healthier lifestyle in comparison to those from private schools. In general, adolescents from public schools exercise more and have a more balanced diet, as the food offered by the public school cafeteria is prepared according to recommendations by nutritionists and many of these students only eat at school[7].

Several publications in our country have shown higher levels of most lipoproteins and lipids in female children and adolescents[1,6,10,31]. However, we did not observe a statistically significant difference between the sexes, although the levels were higher among the girls, especially regarding TG levels.

Based on our data and considering the association between the anthropometric parameters that classify overweight and obesity and the altered lipid profile reported by several studies[2,10,11,26,32], the mean levels of TG and HDL-c, both from overweight participants and those with abdominal obesity, show to be less favorable. These data corroborate those reported by Suárez et al[11], who observed significant differences in lipid levels (TG and HDL-c) between the general population and that presenting overweight and obesity. Grillo et al[26] found a significant association between the low HDL-c levels and the presence of obesity, defined by the BMI, in schoolchildren aged 3 to 14 years. Regarding the TG levels, researchers[33] evaluated the lipid profile of adolescents and found higher TG and lower HLD-c levels in the group with overweight, when compared to the levels observed in the group with normal weight, whereas TC and LDL-c levels did not differ between the two groups.

Regarding the CT and LDL-c levels, our findings are partially in agreement with those found by Suárez et al[11] and Silva et al[34], who did not report differences in LDL-c levels according to the nutritional status. However, they found higher TC levels in overweight and obese schoolchildren, respectively.

Dyslipidemia is frequently secondary to childhood obesity and there is a positive association between the incidence of obesity and dyslipidemia in children and adolescents[9,35]. The mechanism that explains this association is perhaps the activation of the AMP-dependent kinase pathway, induced

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by the increase in insulin and leptin and the decrease in the activation of adiponectin, which, in turn, increases the oxidation of fatty acids. In these children, adiponectin has a positive association with insulin sensitivity and HDL-c levels and a negative association with TG levels[36]. According to Santos and Spósito[37], the main dyslipidemia associated with obesity is characterized by mild and moderated increases in TG and decrease in HDL-c levels, which corroborates the findings of the present study.

The abdominal obesity has shown to be an important predictor of metabolic complications and adverse health effects and it is related to an increase in the cardiovascular and metabolic risk in children and adolescents[17]. The WC and the WHtR are simple and effective ways to measure abdominal obesity in children and can be better predictors of the risk of cardiovascular disease than the BMI[15].

However, the WC has been criticized as it does not include in its calculation the differences in body height and the waist-to-height ratio (WHtR) has been proposed as better predictor of cardiovascular risk[38]. A study by Schneider et al[38], carried out in adult and elderly individuals, verified that the WHtR can predict the prevalence of dyslipidemia better than the other anthropometric parameters, respectively WC and BMI.

In the present study, adolescents with overweight and abdominal obesity (according to the parameter WC) did not present higher LDL-c levels in comparison with the other students. This fact was only observed in those classified as having central obesity, according to the indicator WHtR. Additionally, the TC levels in the adolescents with central obesity, according to this same indicator, showed a tendency toward higher values, when compared to the levels observed in students without abdominal obesity. These findings can suggest that WHtR is the best indicator of possible alterations in the lipid profile.

## Conclusion

The percentage of dyslipidemia in adolescents is high, which demonstrates the need for the measurement of the lipid profile as early as this age range. Overweight and central obesity have an effect on the mean values of these fractions.

The data presented here should serve as a warning to the multidisciplinary team on the need to encourage healthy lifestyle measures among the aforementioned population, mainly regarding the practice of physical activities and healthy dietary habits.

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### 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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## References

1. Franca EF, Alves JGB. Dislipidemia entre crianças e adolescentes de Pernambuco. Arq Bras Cardiol. 2006; 87 (6): 722-7.
2. Carvalho DF, Paiva AA, Melo ASO, Ramos AT, Medeiros JS, Medeiros CCM, et al. Perfil lipídico e estado nutricional de adolescentes. Rev Bras Epidemiol. 2007; 10 (4): 491-8.
3. Sociedade Brasileira de Cardiologia. IV Diretriz brasileira sobre dislipidemias e prevenção da aterosclerose. Arq Bras Cardiol. 2007; 88 (supl 1): S2-19.
4. Coronelli CLS, Moura EC. Hipercolesterolemia em escolares e seus fatores de risco. Rev Saúde Pública. 2003; 37 (1): 24-31.
5. Moura EC, Castro CM, Mellin AS, Figueiredo DB. Perfil lipídico em escolares de Campinas, SP, Brasil. Rev Saúde Pública. 2000; 34 (5): 499-505.
6. Giuliano ICB, Coutinho MSSA, Freitas SFTF, Pires MMS, Zunino JN, Ribeiro RQC. Lípides séricos em crianças e adolescentes de Florianópolis, SC – Estudo Floripa Saudável 2040. Arq Bras Cardiol. 2005; 85 (2): 85-9.
7. Scherr C, Magalhães CK, Malheiros W. Análise do perfil lipídico em escolares. Arq Bras Cardiol. 2007; 89 (2): 73-8.
8. Shehri SN, Saleh, ZA, Salama MM, Hassan YM. Prevalence of hyperlipidemia among Saudi school children in Riyadh. Ann Saudi Med. 2004; 24 (1): 6-8.
9. Sociedade Brasileira de Cardiologia. I Diretriz de prevenção da aterosclerose na infância e na adolescência. Arq Bras Cardiol. 2005; 85 (supl 6): S4-36.
10. Ribeiro RQC, Lotufo PA, Lamounier JA, Oliveira RG, Soares JF, Botter DA. Fatores adicionais de risco cardiovascular associados ao excesso de peso em crianças e adolescentes: o estudo do coração de Belo Horizonte. Arq Bras Cardiol. 2006; 86 (6): 408-18.
11. Suárez NP, Prin MC, Luciani SL, Pilottó MT, Dri MA, Politti IR. Prevalencia de factores de riesgo de enfermedad cardiovascular: obesidad y perfil lipídico. An Pediatr (Barc). 2008; 68 (3): 257-63.
12. Cavalcanti AC. Perfil lipídico de crianças escolares do município de Camaragibe, Pernambuco [dissertação]. Recife: Universidade Federal de Pernambuco; 2007.
13. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem. 1972; 18 (6): 499-502.
14. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign: Human Kinetics Books; 1988.
15. Taylor RW, Jones IE, Williams SM, Goulding A. Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy X-ray absorptiometry, in children aged 3-19 y. Am J Clin Nutr. 2000; 72 (2): 490-5.

16. Cole TJ, Bellizzi MC, Katherine MF, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000; 320 (7244): 1-6.

17. Li C, Ford ES, Mokdad AH, Cook S. Recent trends in waist circumference and wais-height ratio among US children and adolescents. Pediatrics. 2006; 118 (5): 1390-8.

18. Associação Brasileira de Empresas de Pesquisa – ABEP. Critério Padrão de Classificação Econômica Brasil. [Acesso em 2008 mai 23]. Disponível em: http://www.abep.org/codigosguias/Criterio_Brasil_2008.pdf.

19. Sociedade Brasileira de Cardiologia. III Diretriz brasileira sobre dislipidemias e prevenção da aterosclerose. Arq Bras Cardiol. 2001; 77 (supl 3): S4-48.

20. National Cholesterol Education Program. The expert panel on blood cholesterol levels in children and adolescents. Pediatrics. 1992; 89 (Suppl 3): S525-70.

21. Seki M, Bonametti AM, Matsuo T, Seki MO, Andreghetti MR, Carrilho AJF. Avaliação dos intervalos de referência de lípides e lipoproteínas para crianças e adolescentes: associação das dislipidemias e sobrepeso e, escolares de 4 a 19 anos de idade de Maracaí (São Paulo). J Bras Patol Med Lab. 2006; 42 (4): 265-70.

22. Seki M, Niyama FP, Seki MO, Júnior PGP, Seki MO, Bonametti AM, et al. Perfil lipídico: intervalos de referência em escolares de 2 a 9 anos de idade da cidade de Maracaí (SP). J Bras Patol Med Lab. 2003; 39 (2): 131-7.

23. Seki M, Seki MO, Niyama FP, Júnior PGP, Seki MO, Matsuo T, et al. Determinação dos intervalos de referência para lipídios e lipoproteínas em escolares da 10 a 19 anos de idade de Maracaí (SP). J Bras Patol Med Lab. 2003; 39 (4): 309-16.

24. Gama SR, Carvalho MS, Chaves CRMM. Prevalência em crianças de fatores de risco para as doenças cardiovasculares. Cad Saúde Pública. 2007; 23 (9): 2239-45.

25. Cabastini NM, Manfroi WC. Dislipidemia em adolescentes. Revista HCPA. 2004; 24 (2/3): 45-50.

26. Grillo LP, Crispim SP, Siebert NA, Andrade ATW, Rossi A, Campos IC. Perfil lipídico e obesidade em escolares de baixa renda. Rev Bras Epidemiol. 2005; 8 (1): 75-81.

27. Siqueira AFA, Abdalla DSP, Ferreira SRG. LDL: da síndrome metabólica à instabilização da placa aterosclerótica. Arq Bras Endocrinol Metab. 2006; 50 (2): 334-43.

28. Lima SCVC, Arrais RF, Almeida MG, Souza ZM, Pedrosa LFC. Perfil lipídico e peroxidação de lipídeos no plasma e crianças e adolescentes com sobrepeso e obesidade. J Pediatr (Rio J). 2004; 80 (1): 23-8.

29. Luz PL, Favarato D, Junior JRFN, Lemos P, Chagas ACP. High ratio of triglycerides to HDL-cholesterol predicts extensive coronary disease. Clinics. 2008; 64 (4): 427-32.

30. Gerber ZRS, Zielinky P. Fatores de risco de aterosclerose na infância: um estudo epidemiológico. Arq Bras Cardiol. 1997; 69 (4): 231-6.

31. Guedes DPF, Guedes JERP, Barbosa DS, Oliveira JA, Stanganelli LCR. Fatores de risco cardiovascular em adolescentes: indicadores biológicos e comportamentais. Arq Bras Cardiol. 2006; 86 (6): 439-50.

32. Boyd GS, Koenigsberg J, Falker B, Gidding S, Hassink S. Effect of obesity and high blood pressure on plasma lipid levels in children and adolescents. Pediatrics. 2005; 116 (2): 442-6.

33. Faria ER, Franceschini SCC, Pelúzio MCG, Priore SE. Estado nutricional e dislipidemias de acordo com o sexo, em adolescentes atendidos em um programa específico de Viçosa-MG. Rev Bras Nutr Clin. 2006; 21 (2): 83-8.

34. Silva RA, Kanaan S, Silva LE, Peralta RHS. Estudo do perfil lipídico em crianças e jovens do ambulatório pediátrico do Hospital Universitário Antônio Pedro associado ao risco de dislipidemias. J Bras Med Lab. 2007; 43 (2): 95-101.

35. Giuliano ICB, Caramelli B. Dislipidemias na infância e na adolescência. Pediatria (São Paulo). 2008; 29 (4): 275-85.

36. Weiss R, Dziura J, Burget TS, Tamborlane WV, Taksali SE, Yeckel CW, et al.