ORIGINAL ARTICLE

Evaluation of non-HDL cholesterolemia in schoolchildren and teenagers

Avaliação da colesterolenia não HDL em escolares e adolescentes

Manoel Vinicius Rocha Araki[1], Isabela Cristina Rocha Martins[2], Elenilde Gomes Santos[3], Celso de Barros[4]

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ABSTRACT

Objective: to evaluate the serum levels of non-HDL-cholesterol (non-HDL-c) and lipid profile in young people between six and 19 years old. **Method:** this was a cross-sectional and descriptive, and descriptive study. The variables were: total cholesterol and fractions, non-HDL-c, triglycerides, and BMI. Those with disease or using drugs that alter the lipid profile, and patients with triglycerides > 400 mg/dL were excluded from the study. SPSS-17 was used for the analysis of variables. **Results:** 108 young people participated; 63 females. The average of non-HDL-c was 114.7 mg/dL and LDL-c 94.9 mg/dL. There was no significant difference between the values of non-HDL-c and LDL-c between genders and age groups. LDL-c and non-HDL-c showed strong correlation, R = 0.864 and total cholesterol R= 0.890 and R= 0.907, respectively. LDL-c negatively correlated with VLDL-c. Non-HDL-c positively correlated with VLDL-c and triglycerides. The IMC results showed that 3.7% were below normal, 49.1% eutrophic, 23.1% overweight, 24.1% obese. Obese patients showed significantly higher levels of non-HDL-c, VLDL-c, and TG and lower levels of HDL-c compared to eutrophics. The values of non-HDL-c corresponding to 75 and 95 percentiles were 129 and 157 mg/dL, respectively. **Conclusion:** non-HDL-c showed better correlation than LDL-c with different lipid variables and was the best parameter for lipid assessment in obese patients. Thus, non-HDL-c showed to be a reliable and promising method of investigating dyslipidemias in schoolchildren and teenagers.

Key words: Cholesterol, HDL; Cholesterol, LDL; Cholesterol; Dyslipidemias; Children; Adolescent.

[1] MD. Aracaju, SE – Brazil.
[2] MD. Resident in Pediatric Oncology. Erasto Gaertner Hospital. Curitiba, PR – Brazil.
[3] MD. Master degree. Assistant Professor in the Medical School of the Federal University of Sergipe-UFS. Coordinator of Medical Residency in Pediatrics at the University Hospital of UFS. Aracaju, SE – Brazil.
[4] MD. PhD. Associate Professor and Coordinator of the discipline of General Pathological Processes. Deputy Chief of the Department of Medicine at UFS. Aracaju, SE – Brazil.

RESUMO

Objetivo: *avaliar os níveis séricos de não HDL-colesterol (não HDL-c) e perfil lipídico em jovens entre seis e 19 anos.* ***Método:*** *estudo descritivo transversal e descritivo. As variáveis foram: colesterol total e frações, não HDL-c, triglicérides e IMC. Excluíram-se portadores de doença ou em uso de fármaco que alterem o perfil lipídico e pacientes com triglicérides > 400 mg/dL. Utilizado SPSS-17 para análise das variáveis.* ***Resultados:*** *participaram 108 jovens, sendo 63 do gênero feminino. Na amostra total, a média de não HDL-c foi 114,7 mg/dL e de LDL-c 94,9 mg/dL. Não houve diferença significativa dos valores de não HDL-c e LDL-c entre os gêneros e faixa etária. No estudo, o LDL-c e o não HDL-c tiveram forte correlação entre si R= 0,864 e com o colesterol total R= 0,890 e R= 0,907, respectivamente. O LDL-c correlacionou-se negativamente com VLDL-c. O não HDL-c correlacionou-se positivamente com VLDL-c e triglicérides. Quanto ao IMC, 3,7% estavam abaixo do normal, 49,1% eutróficos, 23,1% com sobrepeso e 24,1% obesos. Pacientes obesos apresentaram níveis significativamente maiores de não HDL-c, VLDL-c e TG e nível menor de HDL-c em relação aos eutróficos. Os valores de não HDL-c correspondentes aos percentis 75 e 95 foram 129 e 157 mg/dL, respectivamente.* ***Conclusão:*** *não HDL-c obteve melhor correlação que o LDL-c com diferentes variáveis lipídicas e foi melhor parâmetro*

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Institution:
Department of Medicine,
Federal University of Sergipe (UFS)
Aracaju, SE – Brazill

Corresponding Author:
Manoel Vinicius Rocha Araki
E-mail: vinicius_araki@hotmail.com

na avaliação lipídica em pacientes obesos. Assim, o não HDL-c mostrou-se método confiável e promissor para investigar dislipidemias em escolares e adolescentes.

Palavras-chave: *HDL-Colesterol; LDL-Colesterol; Colesterol; Dislipidemias; Criança; Adolescente.*

INTRODUCTION

Cardiovascular diseases are the leading cause of death in the world, and coronary atherosclerosis is the most common among them, even affecting young people.[1] The atherosclerotic process begins long before clinical manifestations are detected. The fatty streaks appear in childhood and adolescence, and may evolve into atherosclerotic plaques and precipitate ischemic events in adults.[2]

Among the precursors of atherosclerosis, the most influential factor in the acceleration of its progression is dyslipidemia,[2,3] which increasingly appears in children and adolescents and is estimated to reach 38.5% of children in the world.[4,5] The level of cholesterol in childhood is a predictive factor of the level of cholesterol in adulthood.[6] Children with total cholesterol above the 75 percentile present increased thickness of the middle and intimate layer of arteries when adults.[3,7-9] Therefore, the analysis of lipid profiles has clinical importance to detect efficiently and early those with dyslipidemia and at risk of coronary heart disease at a young age.[10]

The Brazilian Guidelines on Dyslipidemias[11] and the National Cholesterol Education Program (NCEP) in the United States, [12] recommend the determination of LDL-cholesterol (LDL-c) by the Friedewald formula as a priority objective to evaluate the risk and treatment for lipid reduction. However, this method presents limitations such as: a) it does not reflect the true serum LDL-c concentration because it is an indirect measurement estimated by the equation of Friedwald[13]; b) it does not evaluate other particles with apolipoprotein B (apo B) that are also atherogenic such as VLDL-c and IDL-c[13]; c) LDL-c becomes progressively less accurate with increased triglyceridemia (TG) and cannot be employed when TG > 400 mg/dL[11, 12]; d) it requires 12 hours fasting for the dosing of TG.[11-14]

Conversely, the non-HDL cholesterol (non-HDL-c), calculated by the difference between total cholesterol (TC) and HDL-cholesterol (HDL-c), includes all cholesterol in atherogenic particles (LDL-c, VLDL-c, IDL-c, and lipoprotein A) and excludes the HDL-c considered anti-atherogenic.[13,14] In addition, its use presents methodological advantages because the determination of non-HDL-c is simple, of low cost, does not require 12 hours fasting, and it is not influenced by TG levels, not requiring its determination.[13-16]

Although dyslipidemias are present since childhood, studies designed to evaluate the non-HDL-c levels in pediatric age are scarce in Brazil. Thus, this study aims to evaluate the levels of non-HDL-c and the lipid profile in young people between six and 20 incomplete years of age.

METHODOLOGY

This was a cross-sectional retrospective study.

Study material: laboratory examinations were evaluated with the information contained in the medical records of patients seen in general clinics from the University Hospital of the Federal University of Sergipe (HU-UFS) in the municipality of Aracaju-SE, between August/2009 and September/2011.

Sampling: male and female patients between six and 20 years of age were included in the study. Those with diabetes mellitus, renal, hepatic, and thyroid disease, in use of drug that alters the lipid profile, or with TG ≥ 400 mg/gL due to the impracticality of the Friedewald formula were excluded. Medical records that did not present these data were discarded.

- **variables of the study**: gender, age, body mass index (BMI), serum levels of total cholesterol (TC), HDL-cholesterol (HDL-c), LDL-cholesterol (LDL-c), VLDL-cholesterol (VLDL-c), non-HDL-cholesterol (non-HDL-c), and triglycerides (TG);
- **analysis of BMI:** the BMI curve by age proposed by the World Health Organisation[17] was used for BMI classification;
- **laboratory analysis**: 10 mL of blood were collected by venipuncture after 12 hours fasting. TC and TG values were quantified by the automated colorimetric enzymatic method (Dimension RXL) and the HDL-c by the accelerating selective automated detergent method (Dimension RXL). LDL-c levels were estimated using the Friedewald formula. The non-HDL-c was defined by the difference between total cholesterol and HDL-c. The analysis followed the reference values of the First Guideline for the Prevention of Atherosclerosis in Childhood and Adolescence (I DPAIA) from the Brazilian Society of Cardiology; [18]

- **data analysis:** the data were coded and stored in a database built in the statistical software SPSS® Data Editor version 17 using the Student's t-test and the Pearson correlation coefficient considering $p < 0.05$ as significant;
- **ethical considerations:** the study was approved by the Committee on Ethics in Research involving humans from the Federal University of Sergipe – CEP/UFS, on 8/19/2009 (CAAE-0078.0.107.000-09).

RESULTS

A total of 108 youngsters were evaluated, being 63 (58%) and 45 (42%) females and males, respectively. The age range was six to 10 incomplete years of age in 40 (37%) schoolchildren and 10 to 20 incomplete years of age in 68 (63%) adolescents, with an average of 10.9 years (± 3.32).

In this study, 37.0% of participants had increased CT and 31.5% in the borderline range. Concerning LDL-c, 9.2% had this value increased while 31.5% were on the borderline range. About 38.9% of the sample had decreased HDL-c values. As for TG, 14.8% had increased values and 19.4% borderline values (Figure 1).

The averages and standard deviations of total cholesterol levels, LDL-c, HDL-c, VLDL-c, non-HDL-c, and triglycerides in the total sample are shown in Table 1. There was no significant difference in the studied variables between genders and between age groups.

Table 2 shows the correlation of LDL-c and non-HDL-c with the lipid variables. In the total sample, LDL-c and non-HDL-c showed a strong positive correlation with each other (R = 0.86) and with total cholesterol (R = 0.89) and (R = 0.907), respectively. A negative correlation between LDL-c and VLDL-c, and a positive correlation between non-HDL-c and VLDL-c and TG were also observed.

In the BMI classification, 3.7% were below normal, 49.1% eutrophic, 23.1% overweight, and 24.1% obese. Table 3 shows the average values of lipids in individuals with normal BMI and in obese. Compared to patients with normal BMI, those obese showed significantly higher levels of non-HDL-c, VLDL-c, and TG, and a low level of HDL-c.

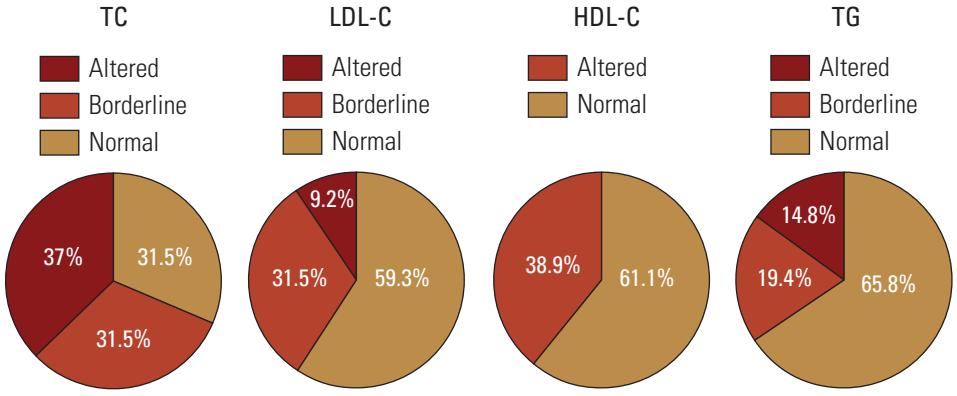

Figure 1 - Classification of serum total cholesterol (TC), LDL cholesterol (LDL-c), HDL- cholesterol (HDL-c), and triglycerides (TG) in the total sample.

Table 1 - Biochemical characteristics according to gender and age

	Total (n=108)	Gender		p	Age		p
		Male (n=45)	Female (n=63)		Children (n=40)	Adolescent (n=68)	
LDL-c	94.9 (±25.7)	90.5 (±29.9)	98.1 (±21.9)	*0.15*	97.7 (±24.9)	93.3 (±26.2)	*0.39*
Non-HDL-c	114.7 (±26.0)	111.5 (±29.1)	117.0 (±23.5)	*0.28*	115.6 (±23.8)	114.2 (±27.3)	*0.78*
Total cholesterol	162.3 (±27.4)	158.5 (±31.2)	165.1 (±24.2)	*0.21*	162.6 (±26.3)	162.2 (±28.2)	*0.95*
HDL-c	47.6 (±11.6)	46.9 (±11.5)	48.1 (±11.7)	*0.62*	46.9 (±10.3)	48.0 (±12.4)	*0.64*
VLDL-c	19.7 (±13.5)	20.9 (±15.8)	18.9 (±11.6)	*0.44*	17.9 (±7.3)	20.8 (±16)	*0.27*
Triglycerides	94.7 (±52.6)	95.2 (±45.1)	94.3 (±57.7)	*0.93*	89.9 (±36)	97.6 (±60.3)	*0.46*

Table 2 - Correlation between LDL-C and non-HDL-C with lipid variables in the overall sample

	LDL-c		Non- HDL-c	
	R*	p	R*	p
LDL-c	–	–	0.864	< 0.001
Non-HDL-c	0.864	< 0.001	–	–
Total cholesterol	0.890	< 0.001	0.907	< 0.001
HDL-c	0.165	0.087	- 0.099	0.308
VLDL-c	- 0.241	0.012	0.280	0.003
Triglycerides	- 0.151	0.120	0.262	0.006

* R from Pearson.

Table 3 - Mean values of lipids in individuals with normal BMI and obese

	Normal BMI	Obese	p
Non-HDL-c	111.9 (±24.2)	126.5 (±29.1)	0.022
LDL-c	97.6 (±23.8)	96.7 (±32.8)	0.89
TC	163.2 (±26.1)	169 (±31.1)	0.39
VLDL-c	14.4 (±5.0)	29.8 (±21.5)	0.0013
HDL-c	51.2 (±10.7)	42.5 (±9.8)	0.00085
TG	71.4 (±25.0)	132.1 (±74.6)	0.00037

The First Guideline for the Prevention of Atherosclerosis in Childhood and Adolescence (I DPAIA) still does not establish reference ranges for non-HDL-c. Therefore, the 75 and 95 percentiles were used, which define the cut-off points for the borderline range and diagnosis of dyslipidemia, respectively. In this sample, the observed 75 and 95 percentiles for non-HDL-c were 129 and 157 mg/dL, respectively (Table 4).

Table 4 - Estimation of reference intervals of non-HDL-c according to percentiles

	Non-HDL-c		
	HU-UFS (n=108)	SEKI[19], 2007 (n=2718)	SRINIVASAN[14], 2002 (n=2843)
P75	129 mg/dL	100 mg/dL	131 mg/dL
P95	157 mg/dL	137 mg/dL	166 mg/dL

DISCUSSION

In this study, the average level of non-HDL-c was 114.77 mg/dL, similar to that found by Srinivasan et al.[14] (115 mg/dL); however, Seki et al.[19] found a lower value (97.5 mg/dL).

Other studies[14,19,20] found levels of non-HDL-c greater in the female gender. In this study, although the average was higher in females than in males, there was no significant difference. No significant difference was observed considering age among schoolchildren and adolescents. Other studies[14, 19, 21] report higher levels in schoolchildren. This data is consistent with the literature[12,22] because the drop in concentrations of TC, LDL-c, and HDL-c during puberty is attributed to the influence of sexual maturation.

LDL-c and non-HDL-c showed a strong correlation such as reported in other studies.[14,19,21] Both showed strong correlation with TC, and these values were similar to those found by Srinivasan et al.[14] and Seki et al.[19]

Other studies[14,19] found a negative correlation between LDL-c and non-HDL-c and HDL-c (which is consistent with the anti-atherogenic action of HDL-c). In this study, although not statistically significant, a negative correlation was observed only with the non-HDL-c.

In relation to VLDL-c, both showed significant correlation. However, a positive correlation was only observed with non-HDL-c. As expected, a positive correlation between non-HDL-c and TG was observed; this did not occur between LDL-c and TG.

The obese patients exhibited significantly higher levels of non-HDL-c compared to patients with normal BMI (P = 0.02). No significant difference (P = 0.89) was observed in the LDL-c values between these two groups. Other authors[14,21] also found that the non-HDL-c was better associated than LDL-c in relation to BMI and suggest that the non-HDL-c can be a better parameter for monitoring results related to weight control, diet, and physical activity.

In this sample, the 75 and 95 percentiles found for non-HDL-c were 129 and 157 mg/dL, respectively, which were higher values than those found by Seki et al.[19], however similar to those found by Srinivasan et al.[14]. Thus, the data in this sample contribute to estimating the values of non-HDL-c in Brazilian children and adolescents since there are no reference values proposed by the SBC for this age group.

CONCLUSION

This sample demonstrated that 37.0; 9.2; 38.9; and 14.8% of participants showed altered values in the evaluation of CT, LDL-c, HDL-c, and TG, respectively.

There was no significant difference in the levels of TC, LDL-c, HDL-c, VLDL-c, non-HDL-c, and TG in relation to gender and age group.

Non-HDL-c shows better correlations than LDL-c with the studied lipid variables, i.e., levels of non-HDL-c were more consistent with studies that demonstrate its correlation with atherogenic profiles.

Obese patients showed increased levels of non-HDL-c, TG, and VLDL-c and lower level of HDL-c compared to eutrophic patients. The non-HDL-c was better than LDL-c as a parameter for lipid assessment in obese patients.

Because this is a cross-sectional study, a subsequent longitudinal follow-up is needed to determine the clinical significance of the observed results compared to LDL-c levels and, thus, evaluate the behavior of non-HDL-c among the participants in the case of future cardiovascular diseases.

The results from this study lead to the conclusion that the non-HDL-c proved to be a reliable and promising method for investigating dyslipidemias in schoolchildren and teenagers, and may be included in the laboratory evaluation of lipid profiles.

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