Dyslipidemia Among Adolescents and Children from Pernambuco

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Objective: To describe the prevalence of dyslipidemia and overweight among children and adolescents in the state of Pernambuco, Brazil.

Methods: During clinical evaluation, a questionnaire was completed through interviews with parents and included personal details of the children and adolescents. An exclusion criterion was personal or parental history of diabetes or coronary artery disease (CAD). Blood samples were collected from subjects who had been fasting for 12 hours, and the following evaluations were performed using enzymatic methods: serum Total Cholesterol, LDL-Cholesterol, HDL-Cholesterol and Triglycerides. Data were analyzed using the SPSS 11.5 statistical package including Student's t test and Fisher's exact test.

Results: Of the 414 children and adolescents analyzed in the present study, about 30% presented an atherogenic lipid profile, characterized by higher levels of Triglyceride, Total and LDL- Cholesterol. The prevalence of overweight in this sample from Pernambuco was 4%. Girls had higher levels of Triglycerides and Total Cholesterol than boys. Children and adolescents presented the same values of lipid on blood that is not expected for children in this phase of development.

Conclusion: In the present population, an unfavorable lipid profile among children and adolescents from Pernambuco suggests that programs targeting the prevention of cardiovascular disease and obesity must begin early in life.

Key words: Dyslipidemia, overweight, coronary atherosclerosis, children, adolescent.

Dyslipidemia is a condition in which there is an abnormal lipid or lipoprotein concentration in the blood. It is well established that it is determined by both genetic and environmental factors[1,2]. A large body of evidence gathered over several decades, including epidemiological, animal, metabolic and clinical evidences, has shown that elevated levels of Total Cholesterol, LDL-Cholesterol and Triglyceride are correlated with a higher incidence of hyperlipidemia, hypertension, and atherosclerotic disease[3-8]. These diseases arise as a consequence of the formation of lipid plaques deposited in the arterial wall that can obstruct the lumen of the blood vessels.

Early detection of high blood cholesterol in asymptomatic persons allows the identification of an important modifiable risk factor for coronary artery disease (CAD). Clinical manifestations of CAD, such as myocardial infarction, stroke and peripheral vascular disease, generally have onset from middle age onwards. In the United States, cardiovascular diseases accounted for 38.5 percent of all deaths in 2001[9,10]. Brazilian data reveal that cardiovascular diseases outweigh other causes of deaths and in 1998 were responsible for 27% of deaths[11]. In Recife, a city the Northeastern region of Brazil, an increase in ischemic heart disease was observed at younger ages (30 to 49 years of age) in 1998. This data is alarming because in 1995 the Northeastern region had the greatest proportion of mortality without a defined diagnosis[12]. It has been observed that the BMI categories of both overweight and obese are related to increased mortality[13,14]. In some countries, demographic, socioeconomic and epidemiological changes have allowed for a transition in nutritional patterns increasing significantly the prevalence of overweight (BMI 25-29.9 Kg/m^2) and obesity (BMI $\geq$ 30 Kg/m^2) in the pediatric population[15,16] warning against a worldwide epidemic. Because of the increasing costs of medical service, it is important to identify subjects at risk of developing dyslipidemia or overweight as soon as possible. The question of whether the lowering of serum cholesterol can achieve a significant reduction in the incidence of CAD in asymptomatic persons has been of major clinical interest. Cholesterol screening during childhood has received increased attention in recent years. The detection of high blood cholesterol during childhood is of potential value in identifying those children who are at increased risk for developing CAD as adults and who might benefit from more intensive dietary interventions. Few Brazilian studies have investigated lipid profile and overweight as a preventive factor in identifying the individual risk of developing CAD in adolescents and children[17-21]. CAD is uncommon in young adults, and it has different characteristics from that in older patients. However, children and adolescents with sedentary lifestyles and a high-fat and high-sugar diet are at higher risk for coronary disease. But in young subjects, the absence of exposure to factors such as tobacco consumption and alcohol intake permit a better definition of the adequated plasma

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lipid profile. The purpose of this study was to describe the lipid profile and to estimate the prevalence of dyslipidemia and overweight among children and adolescents aged 5 to 15 years in the state of Pernambuco, Brazil.

Methods

The sample consisted of 414 healthy children ages 5 to 15 (mean 8.9 ± 2.9) who went through routine visits at a pediatric hospital (Instituto Materno-Infantil de Pernambuco) in Recife, the capital of the Brazilian Northeastern State of Pernambuco. All children and adolescents were born in Pernambuco. A questionnaire was completed through interview with the parents and included details concerning medical history, drug intake, and lifestyle variables such as physical activity and demographic data. The exclusion criteria were: secondary hyperlipidemia from renal, liver or thyroid disease, diabetes and parental history of diabetes or coronary artery disease. The subjects were instructed to fast for 12 hours prior to venipuncture. This investigation was approved by the Hospital Ethical Committee. The parents and/or guardians of the subjects gave their written consent and probands provided verbal consent after receiving detailed and specific information about the risks and benefits of the study.

Anthropometric measurements - The weight and height of the subjects were measured in the morning after 12 hours of fasting. Height was measured to the nearest centimeter using a rigid stadiometer. Weight was measured to the nearest 0.1 Kg using an electronic calibrated scale. The body mass index (BMI) was expressed as weight (Kg) divided by the square of the height (m^2). It was used to estimate the prevalence of overweight suggested by the World Health Organization[5] and by Cole et al[22] who proposed the use of BMI adjusted to age and sex.

Biochemical analyses - One blood sample (5ml) was collected into vacutainer tubes, and the serum was separated from red cells by centrifugation to measure Total Cholesterol, HDL-Cholesterol, and Triglycerides concentrations. These biochemical parameters were determined by standard enzymatic methods (Roche Diagnostics) on a Hitachi automated spectrophotometer. LDL-Cholesterol was calculated according to Friedwald et al[23]. The cut-off values for abnormal lipid levels were those determined by the National Cholesterol Education Program NCEP guidelines[24] and by the Brazilian Cardiology Society[25].

Statistical analyses - Statistical analyses were performed using the SPSS 11.5 statistical package. All continuous variables, except triglycerides, were normally distributed. All lipid values were analyzed separately by gender, and adjusted for age and BMI by linear regression analysis. Differences in mean lipid levels between genders were compared using the Student's t test. Dyslipidemic and normolipidemic subjects were compared using Fisher's exact test.

Results

The sample characterization and comparison between boys and girls are given in Table 1. Of the 414 children and adolescents, 221 (53.4%) were boys and 193 (46.6%) were girls. There were no significant differences in age and anthropometrical measures such as weight, height, waist or hip circumferences among boys and girls ($p > 0.05$). Mean lipid levels, such as HDL-Cholesterol, LDL-Cholesterol, and Total Cholesterol/HDL-Cholesterol ratio and BMI, did not differ among boys and girls either. However, the mean of total cholesterol and triglycerides levels were significantly higher in girls compared to boys ($p = 0.03$ and $p = 0.04$, respectively). According to BMI values of adults[5], the analysis revealed that 4.1% of the adolescents and children were overweight.

Table 2 shows lipid levels presented by children and teenagers without family history of cardiovascular disease. Triglyceride levels and BMI were higher ($p<0.00$) among teenagers than among children as is expected for that phase of their development. However, the levels of Total Cholesterol, LDL-Cholesterol, HDL-Cholesterol and TC/HDL-Cholesterol ratio presented by children with ages between five and nine was the same observed among as the adolescents with ages between 10 and 15 ($p>0.137$) that is not expected for children in this phase of development.

Variable	Boys (n =221)	Girls (n =193)	p (t-test)
Age (years)	8,93 ± 2,91	9,07 ± 2,94	0,63
Weight (Kg)	32,47 ± 11,87	32,70 ± 12,38	0,85
Height (m)	1,34 ± 0,17	1,33 ± 0,17	0,59
Waist (cm)	64,00 ± 9,52	64,50 ± 9,26	0,59
Hip (cm)	70,92 ± 10,31	72,72 ± 11,46	0,09
BMI (Kg/m2)	17,52 ± 3,34	17,76 ± 3,40	0,48
TC (mg/dL)	154,18 ± 25,49	159,78 ± 27,93	0,03
LDL-C(mg/dL)	94,21 ± 21,96	97,26 ± 24,72	0,18
HDL-C (mg/dL)	43,90 ± 9,09	44,97 ± 9,88	0,25
TC/HDL-C ratio	3,62 ± 0,77	3,70 ± 0,84	0,43
TG (mg/dL)	80,35 ± 33,41	87,75 ± 38,18	0,04

Table 1 - Baseline characteristics (mean ± standard deviation) of children and adolescents (n=414) from Pernambuco, Brazil

Variable	Age 5 to 9 (n=244)		Age 10 to 15 (n= 170)		p
	Mean	SD	Mean	SD	
TC (mg/dL)	157,78	26,25	155,37	27,51	0,368[S]
LDL-C (mg/dL)	96,99	23,10	93,67	23,53	0,155[S]
HDL-C (mg/dL)	44,98	9,31	43,57	9,66	0,137[S]
TC/HDL-C ratio	3,62	0,80	3,69	0,82	0,383[S]
TG (mg/dL)	79,06	31,63	90,61	40,32	0,004[MW]
BMI (Kg/m²)	16,86	2,87	18,74	3,70	0,000[MW]

SD - Standard Deviation; S - t-Student test; MW - Mann-Whitney test.

Table 2 - Lipid values and BMI among children and adolescents without family history of Coronary Artery Disease (CAD)

Table 3 shows reference values for lipids of children and adolescents up to 19 years old. More than 70% of all subjects in the study presented an acceptable lipid profile characterized by higher HDL-Cholesterol levels and lower levels of Triglycerides, Total and LDL-Cholesterol. It was found that about 24% and 15% of all subjects had, respectively, Total and LDL-Cholesterol levels borderline raised, while about 6% and 10% of the subjects presented high total and LDL-Cholesterol levels (greater than the 95th percentile), respectively. About 19% of the children under age 10 and 12% of the adolescents presented plasma Triglyceride levels higher than those recommended for these ages.

The frequency of dyslipidemia by gender is presented in Table 4. Of the 414 children and adolescents studied, 29.7% presented elevated plasma lipid levels. Results also showed that there are more dyslipidemic girls (34.7%) than boys (25.3%, p = 0.04).

Discussion

The National Cholesterol Education Program (NCEP)[26], in the United States, recognizes the changes in the plasma lipid levels in the general population as one of the traditional risk markers for coronary atherosclerosis. Atherosclerotic cardiovascular disease is one of the most serious problems in public health in many countries such as Brazil[25] because many subjects with lipid disorders remain unidentified or undertreated and, therefore, continue to have an unfavorable blood lipid profile, increasing the risk for coronary events[27]. This is a dangerous situation because the atherosclerotic process and overweight related to lipid levels formerly observed only in adults now begin early in childhood[28-30].

The relevant findings in the present study were: 1) the difference in the mean triglyceride and total cholesterol between boys and girls (Tab. 1) concurs with previously reported results concerning children and adolescents of similar age[31,32]; b) there is a high prevalence (29.7%) of one of the classic risk factors for coronary atherosclerosis characterized by elevation in the cholesterol level among 414 children and adolescents aged five to fifteen. This frequency is lower than that observed in schoolchildren (35%) and in several adult populations (40%) from Brazil[19,32]. However, any increase in the prevalence of dyslipidemia and overweight in adults and mainly in children is very important because they are among the most important risk factors for the development of coronary artery disease, one of the three main causes of morbidity and mortality in Brazil[11,33,34].

According to the World Health Organization[35], about 84% of the adolescents (10 to 19 years old) are in developing countries such as Brazil and their percentage in relation to other groups has increased. However, little attention has been given to lipid profile among Brazilian adolescents[18,19]. The National Cholesterol Education Program[24] recommended the selective screening of children and adolescents (after 2 years of age) whose parents

Lipid	Age (years)	Normolipidemic	Borderline	Dislipidemic
TC	< 19	291 (70,3%)	98 (23,7%)	25 (6,0%)
LDL-C	< 19	309 (74,6%)	63 (15,2%)	42 (10,2%)
HDL-C	< 10	180 (73,8%)	–	–
HDL-C	10 – 19	141 (82,9%)	–	–
TG	< 10	198 (81,1%)	–	46 (18,9%)
TG	10 – 19	149 (87,6%)	–	21 (12,4%)

**Valente et al28; **BSC11; TC - Total Cholesterol, LDL-C - LDL cholesterol, HDL-C - HDL cholesterol, TG - Triglycerides.*

Table 3 - Frequency distribution (n and %) of lipid levels by age among children and adolescents from Pernambuco according to values recommended by the NCEP* and the Brazilian Cardiology Society**

	Girls	Boys	All
	n (%)	n (%)	n (%)
Normolipidemic	126 (65,3)	165 (74,7)	291 (70,3)
Dislipidemic *	67 (34,7)	56 (25,3)	123 (29,7)

Comparison between normolipidemic versus dislipidemic: p = 0.04 (Fisher's exact test)

Table 4 - Frequency distribution of dyslipidemia according to gender among 414 children and adolescents from Pernambuco, Brazil

or grandparents had had myocardial infarction, angina pectoris, peripheral vascular disease, cardiovascular disease or sudden vascular disease at age 55 or earlier. In contrast, some authors have reported that in the selective screening those subjects without a positive family history of elevated cholesterol level would be missed. In fact, only 40% of white children and 21% of black children with elevated levels of LDL cholesterol had a parent with a history of vascular diseases[36,37].

Our study found children and adolescents presenting similar lipid levels (Tab. 2). This data should be closely examined because it indicates that very young children, between five and nine years of age, already present an inadequate lipid profile. This is probably suggestive of the influence of family eating habits and lifestyle.

Twelve to nineteen percent of the children and adolescents had triglyceride levels above those considered ideal for their age (Tab. 3). This data is in agreement with that of other researchers who found elevated triglyceridemia in 13% of a group of 2 to 9 years of age with family history of premature CAD[21].

Comparing different cut off values for BMI, Monteiro et al[38] showed that a BMI cut off of 25Kg/m^2 presented the best performance for screening overweight. Based on this criterion the data shows that the prevalence of overweight among Pernambucan children and adolescents (4.1%) was lower than those reported by Neutzling et al[17] in another sample of Brazilian adolescents (7.7%). However, the BMI in childhood and adolescents changes substantially with age, and clearly a cut off point related to age is necessary to better define obesity in both children and adolescents[22]. Throughout developed and developing countries obesity has increased rapidly[16,39]. The adverse health consequences of adult obesity are well documented, but are less certain for obesity in both children and young adults. Investigations suggest that 33% of adult obesity originates from childhood obesity[40], and it is associated in adolescence with several problems, from which the most prevalent are the psychosocial consequences[41,42]. Thus, the importance of achieving a reliable and accurate estimate of body fatness is essential not only for the prevention but also for the treatment of overweight in children and adolescents.

Conclusions

In conclusion, the high prevalence of bad elevated lipid profiles (29.7%) among children and adolescents without parental history of coronary artery disease identified in the present study (Tab. 4) suggests that preventive screening must begin during childhood because it may identify young people at risk of developing premature coronary heart disease in the future. Studies of the lipid profile will aid in the reduction of the high mortality taxes for diseases of the circulatory apparel. Similar investigation in other areas is suggested in order to stablish adequate classification of dyslipidemias in adolescents and children from the Brazilian northeastern region.

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Potential Conflict of Interest

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

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