

Risk Factors for Atherosclerosis in Students of a Private University in São Paulo - Brazil

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Objective - To characterize the risk profile for atherosclerosis (AS) in adolescents and young adults of a private university in São Paulo.

Methods - Clinical, nutritional, and laboratory parameters were evaluated in 209 students of both genders aged 17 to 25 years. In addition to determination of the lipid profile, the association of its abnormal values with other risk factors for AS was also investigated.

Results - Increased levels of total cholesterol, LDL-C and triglycerides (TG) were observed in 9.1%, 7.6% and 16.3% of the students, respectively, and decreased levels of HDL-C in 8.6% of them. Prevalence of the remaining risk factors analyzed was elevated: sedentary life style (78.9%); high intake of total fat (77.5%); high cholesterol intake (35.9%); smoking, hypertension (15.8%) and obesity (7.2%). There was an association between elevated LDL-C and TG levels and sedentary life style and body mass index.

Conclusion - The high prevalence of risk factors for AS in young individuals draws attention to the need for adopting preventive plans.

Key words: atherosclerosis, risk factors, adolescents, young adults

Atherosclerosis, a chronic disease of multifactorial etiology¹, is one of the major causes of morbidity and mortality in the adult population, including Brazil^{2,3}.

Traditionally, atherosclerosis (AS) is considered a typical disease of middle age. Coronary heart disease (CHD), its most frequent and lethal form, reaches a significant index of incidence from 45 years onwards in men and 55 years onwards in women. However, the atherosclerotic process starts several decades before its clinical manifestations (myocardial infarction, cerebral stroke, peripheral vascular disease) arise⁴, as data obtained from autopsy studies indicate⁵⁻⁷.

Generally, there is a long asymptomatic period preceding the clinical manifestations of atherosclerosis⁸. The rate of progression of the atherosclerotic process is variable, depending on the number and prevalence of risk factors (RF) identified⁴. Most risk factors begin or are acquired in childhood⁹, and tend to persist over time¹⁰.

Due to the increasing and high cost of the treatment of this disease, investments in preventive measures have become a priority⁴. Understanding of the magnitude of multiple RFs for AS and identifying them in the different age ranges are essential for devising effective prevention plans. Preventive measures should fit with the reality of the local environment, so that they can be implemented effectively. In addition, developing a plan that is appropriate for the local reality where it is going to be implemented is fundamental.

Considering the low number of national epidemiological studies of the risk factors for atherosclerosis in Brazil, our objective was to describe the frequency of some RFs for AS in adolescents and young adults in São Paulo, taking gender into consideration. We also aimed to identify the RFs associated with total cholesterol (TC), and elevated LDL-cholesterol and triglyceride (TG) levels, and with low HDL-cholesterol levels.

Methods

During the 1st semester of 1997, we evaluated 209

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freshmen of both genders, ranging in age from 17 to 25 years, attending a private university in São Paulo. The evaluation process consisted of three steps (clinical, nutritional and laboratory parameters) and the participation was voluntary. During the clinical evaluation, the freshmen answered a standardized questionnaire aiming to investigate the presence of RFs for AS and they underwent a physical examination. Anthropometric (weight and height) and nutritional (food record of 24 h) data were obtained during the nutritional evaluation. The choice of the 24 h food record as an instrument to evaluate total fat and cholesterol intake was based on the need for a qualitative rather than quantitative analysis. Through biochemical analysis, the values of TC and its fractions, TG and glycemia were obtained. Association of alterations in the lipid profile with other RFs, such as positive history for AS, hypertension, diabetes mellitus, obesity, smoking, diet, and sedentary life style was also investigated.

Lipid profile values were analyzed according to the II Consenso Brasileiro sobre Dislipidemia (Brazilian Consensus on Dyslipidemia)¹¹. This recommendation establishes distinct reference values for age groups from 2 to 19 years and ≥ 20 years. Therefore, the students in our study were divided into two groups according to age: subjects aged 17 to 19 years and subjects aged 20 to 25 years.

The presence of 1st degree relatives with manifest AS (CHD and/or cerebrovascular disease and/or peripheral vascular disease) under the age of 55 years for males and 65 years for females was considered as a positive family history¹¹.

Regarding blood pressure, the reference values adopted adhered to the recommendations of the V Joint National Committee¹², defining hypertension as diastolic pressure ≥ 90 mmHg and systolic pressure ≥ 140 mmHg.

The diagnosis of diabetes mellitus (fasting glycemia ≥ 126 mg/dL) adhered to the standards of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus¹³.

According to body mass index (BMI), individuals were classified as follows: undernourished (BMI < 18.5 kg/m²); eutrophic (BMI ≥ 18.5 and ≤ 24.99 kg/m²); degree I of overweight (BMI ≥ 25 and ≤ 29.99 kg/m²); degree II of overweight (BMI ≥ 30 and ≤ 39.99 kg/m²); degree III of overweight (BMI ≥ 40 kg/m²)¹⁴. Those with BMI ≥ 30 kg/m² were considered obese¹¹.

Individuals who smoked regularly, inhaling the smoke, an average of three or more cigarettes per day, for a period ≥ 1 year, were considered smokers¹⁵.

Total fat intake > 30 g and cholesterol intake > 300 mg/day was classified as excessive¹¹.

Students denying a regular practice of physical activity with a frequency \geq twice a week and minimal duration of 30 min were considered sedentary.

In the statistical analysis, to characterize the lipid profile regarding gender, the mean values were compared using the Student's *t* test, when the variables were homogeneous. When the variables were heterogeneous, the means were compared using Kruskal-Wallis' test. Com-

parison of the variances was made by using the Bartlett's test. The possible association of RFs for AS with the values of lipid profile was evaluated by means of the chi-square test using Yates' correction. In all analyses, the significance level used was 5%.

Results

Of the 209 students evaluated, 72.2% were women and 52.6% were in the age range of 17 to 19 years.

Data regarding the values of the lipid profile (mean, minimum and maximum) according to gender are shown in table I. Women had a mean HDL-C level higher than men did, with no statistically significant differences when compared with other mean values.

Dyslipidemias, characterized by increased levels of TC and LDL-C, occurred in 9.1% and 7.6% of the sample, respectively. However, TC levels above that which is considered desirable (borderline and high) were observed in 39.7% of the women and 29.3% of the men ($p=0.215$). Elevated levels of LDL-C were also higher in women (19.9%) when compared with those found in men (15.5%) ($p=0.536$).

Reduced levels of HDL-C were observed in 8.6% of the students, and this percentage was higher in men (17.2%) than in women (5.3%) ($p=0.013$).

Hypertriglyceridemia was found in 16.3% of the sample. Increased levels of TG were higher in men (24.1%) than in women (13.2%) ($p=0.088$).

Regarding the other RFs analyzed, sedentary life style, which occurred in 78.9% of the sample, was the most prevalent RF followed by high total fat intake (77.5%). Smoking and hypertension had the same prevalence (15.8%). From the 33 hypertensive individuals, 60.6% were male. Obesity was observed in 7.2% of the sample, and its frequency was greater in women (tab. II).

Statistically significant associations of sedentary life style with LDL-C ($p=0.050$) and TG ($p=0.032$) levels above the desired values were observed, as well as an association of BMI with TC ($p=0.011$), LDL-C ($p=0.030$) and TG ($p=0.007$) levels. BMI showed a directly proportional relation to TC and LDL-C levels, and the greatest percentage of increased serum TG levels was observed in obese students (BMI ≥ 30 kg/m²).

Discussion

Regarding the composition of the sample studied, it is important to note that the 209 freshmen evaluated represented 25.1% of the students entering that particular university in that period. From 832 freshmen, 527 (65.3%) were women. The predominance of females in our sample (72%) was due essentially to a higher number of women entering that university at that time.

A high prevalence of RF for AS in this sample was observed. This is in accordance with the national and international literature, in which the prevalence of RF in young individuals was also high.

Alterations in lipid profiles are important in deter-

Table I – Data regarding serum total cholesterol and its fractions (HDL-C, LDL-C) and triglycerides levels (mg/dL) of the sample studied according to gender

Variable		Female	Male	P
Total cholesterol	Min - Max	106 - 260	109 - 250	0.410 ^T
	Mean (SD)	178.25 (32.55)	168.93 (37.20)	
HDL-c	Min - Max	23 - 80	24 - 80	< 0.001 ^T
	Mean (SD)	51.48 (11.40)	44.72 (11.23)	
LDL-c	Min - Max	17 - 182	51 - 174	0.915 ^T
	Mean (SD)	99.25 (29.86)	98.76 (31.06)	
Triglicérides	Min - Max	48 - 397	57 - 399	0.270 ^K
	Mean (SD)	112.85 (46.38)	129.03 (68.75)	

^T - Student's t test; ^K - Kruskal-Wallis test.

mining the development of AS¹⁶. The indices of mortality due to CHD are directly related to the mean serum TC levels of the population¹⁷. The mean TC level in this study was 172.05±33.86mg/dL, and there was no statistically significant difference between the mean values for men and women. In Brazil, Gerber and Zielinsky¹⁸, evaluating students who were 6 to 16 years of age, both from public and private school systems, reported a mean TC of 167.22 ± 30.57. Forti et al¹⁹, despite having included in their study only young people with a positive family history, obtained similar data. A mean <150mg/dL was described by Bertolami et al²⁰ in the group aged 14 to 21 years. The reduced number of individuals in this group (N=80) may have been responsible for the finding. Regarding the national studies evaluating individuals in the age group of 20 to 29 years, the greatest mean of TC observed did not exceed 200mg/dL²¹⁻²⁴.

Although the means of TC, in most of the Brazilian studies, were not elevated, the frequency of undesirable levels was very high regardless of the age range and region of the country. In the study by Gerber and Zielinsky¹⁸, of 1502 students who were 6 to 16 years old, 27.8% of the sample had TC levels >180mg/dL. Studies carried out in the states of Bahia²⁵, Rio Grande do Sul²¹ and São Paulo²³, in

the adult population, showed similar proportions of undesirable TC levels (>35% full sample). In our study, 9.1% of the freshmen had increased TC levels. This proportion increases to 36.8% if we consider those with TC levels above the desirable values. Regarding the international studies, 24% of the young people evaluated in the Muscatine Study had TC levels >200mg/dL²⁶. In the Framingham Heart Study²⁷, 48% of the men and 26% of the women aged 31 to 39 years had TC levels >220mg/dL.

In the present study, the mean LDL-C was lower than 100mg/dL in both genders. Considering the whole sample, 26.3% had LDL-C levels above the desirable levels and 7.6% of the sample had increased levels. There was no significant association of LDL-C levels with gender. The frequency of subjects with undesirable LDL-C levels, an important risk predictor for AS, was also elevated in other Brazilian studies^{20,23}.

A mean HDL-c of >45mg/dL was observed in individuals of both genders but it was higher in women. Most of the sample had desirable HDL-C levels (94.7% of the women and 82.8% of the men). However, while the percentage of men with low levels was 17.2%, the percentage of women was only 5.3%. Other national studies showed mean levels

Table II - Serum total cholesterol and its fractions (HDL-C, LDL-C and triglycerides levels (mg/dL) according to gender

Variable	Female (N=151) N° (%)	Male (N=58) N° (%)	Total (N=209) N° (%)	P
Age range				
17 to 19 years of age	84 (76.4)	26 (23.6)	110 (100)	0.212 ^Y
20 to 25 anos years of age	67 (67.7)	32 (32.3)	99 (100)	
Positive familial history	34 (82.9)	7 (17.1)	41 (100)	0.131 ^Y
Hypertension	13 (39.4)	20 (60.6)	33 (100)	<0.001 ^Y
Smoking	24 (72.7)	9 (27.3)	33 (100)	0.884 ^Y
Sedentary life style	119 (72.1)	46 (27.9)	165 (100)	0.912 ^Y
Body mass index				
- Undernourished	19 (86.4)	3 (13.6)	22 (100)	0.085 ^Y
- Eutrophic	100 (75.2)	33 (24.8)	133 (100)	
- Degree I overweight	23 (59.0)	16 (41.0)	39 (100)	**
- Degree II overweight	8 (57.1)	6 (42.9)	14 (100)	
- Degree III overweight	1 (100)	0 (0.0)	1 (100)	
High intake of total fat	36 (76.6)	11 (23.4)	47 (100)	0.568 ^Y
High intake of cholesterol	103 (76.9)	31 (23.1)	134 (100)	0.067 ^Y

^Y - Association of the chi-square test with Yates' correction; ** - In the chi-square analysis, the categories II and III were grouped.

of HDL-C > 45mg/dL in individuals <20 years old^{18,19} and >40mg/dL in individuals from this age on^{20,28,29}. Regarding gender, Kannel et al³⁰ report higher HDL-C levels in women regardless of age. In addition, HDL-C shows a strong inverse relation to sexual maturation in white men³¹.

Regarding TGs, their mean in this study was <120mg/dL and 16.3% of the sample showed increased TG levels. Despite the small age difference, it is remarkable that 20 to 25-year-old individuals showed TG means significantly greater than those 17 to 19 years of age. As alcohol consumption may lead to hypertriglyceridemia by increasing hepatic TG synthesis³², one may speculate that there is an increase of alcohol ingestion among 20 to 25-year-old students.

Sedentary life style in this study was the most prevalent risk factor among the students evaluated. It is known that, currently, television, video games and computers occupy a great part of young people's free time³³. However, in regard to reduction in physical activity in the group studied, one may speculate about the involvement of other factors. Lack of interest in schools in promoting this kind of activity, mainly in the year preceding the entrance to the university; nonexistence of physical education classes in college preparatory courses, and reduction in extracurricular activities in this period may have contributed to the elevated frequency of sedentary life styles seen (78.9%).

In the present study, there was an association between sedentary life style and increased LDL-C and TG levels. These findings support those in the literature. However, we found no association with diminished levels of HDL-C.

From the environmental variables involved in the determination of lipid profiles, diet is considered one of the most important³⁴. Excessive caloric intake of fat and cholesterol is associated with increased serum levels of TC and LDL-C³⁵. In our study, 77.5% of the sample showed total fat intake >30% of the total calories and 35.9% showed cholesterol intake \geq 300mg/day. Despite the high frequency of individuals with undesirable food habits, no association between lipoprotein alterations and high intake of total fat and cholesterol was observed. The fact that our nutritional evaluation did not identify the saturated fat portion of the diet may have contributed to the absence of this association. In addition, only a few intrapopulation epidemiological studies reported a consistent association of diet with levels of serum lipids³⁶. This association is clearer in studies aiming to compare different populations, such as the Seven Countries Study³⁷. In this study, the strong association of fat intake with serum cholesterol levels, seen in comparing different cohorts, was not observed in any particular cohort. As mentioned by Dressler et al²⁸, intraindividual variability, both in the diet and in serum cholesterol levels, may reduce the possibility of detecting the presence of associations in one population. However, "random" variations may be minimized by obtaining the mean among individuals, which allows demonstration of possible associations in comparing different populations.

In our study, 19.6% of the sample had a positive family history and its association with lipid profile alteration was not observed. Several studies reveal the greater prevalence of RF in 1st degree relatives of individuals with manifest AS, when compared with those without family history for this disease³⁸. Forti et al¹⁹ observed elevated frequency of lipid metabolism changes and of body weight increase in children and adolescents of young patients with coronary heart disease. In comparing the prevalence of primary dyslipidemias among 1st degree relatives of revascularized coronary heart disease patients and individuals without CHD familial history, Giannini et al²⁹ reported greater frequency of improper lipid levels in the first group. Other authors did not find this relation. However, in the study by Gerber and Zielinsky¹⁸, 61.67% of the students with hypercholesterolemia did not have positive familial history for AS. These data are similar to those reported in the Bogalusa Heart Study³⁹, in which familial history was positive only in 40% of the young white hypercholesterolemic people and 21% of the black hypercholesterolemic people.

The relation between diastolic and systolic pressure levels and cardiovascular risk has already been very well established. In the present study, 15.8% of the students had hypertension, and 60.6% of them were men. Hypertension also predominated in 20 to 39-year-old men in the study by Martins et al⁴⁰. As already mentioned in the introduction, pressure levels tend to be higher in young males⁴¹. Some studies reported an association of hypertension with increased cholesterol levels^{24,40,42}; this association, however, was not observed in our study.

The frequency of smokers observed in this sample was 15.8%. From adolescence on, smoking is one of the most harmful influences in the progression of atherosclerotic plaque⁶. Craig et al⁴³ showed through metaanalysis that smoking relates to reduction in the HDL-C levels in individuals aged 8 to 19 years, similarly to that which occurs in adults. However, like Forti et al¹⁹, we did not observe any association between the variables of the lipid profile and smoking. The different criteria used to determine the presence of smoking may contribute to the disagreement regarding this association. In the Framingham Heart Study⁴⁴, CHD risk was related to the number of cigarettes smoked per day. A consumption >10 cigarettes per day related to lipoprotein alterations (higher TC and LDL-C levels in addition to lower HDL-C levels).

Obesity (BMI \geq 30kg/m²) was observed in 7.2% of our sample, of which 60% were females and 40% males. Although analyzing a younger age range, Gerber and Zielinsky¹⁸ also reported a relatively low frequency (6.33%) of obesity. Other studies, however, report a higher incidence of obesity^{19,45}. Regarding BMI, the undernourishment among students in a private university in São Paulo should be noted (10.5%). Possibly due to the current beauty trend emphasizing thinness and the stronger social pressure upon women, it was observed that the most undernourished individuals were females (86.4%).

In our study, a statistically significant BMI asso-

ciation with serum TC, LDL-C, and TG levels was observed. BMI showed a directly proportional relationship with serum TC and LDL-C levels. The greater the BMI, the greater the percentage of levels of these substances above the desired values. The greatest percentage of increased serum TG levels was observed in degrees II and III overweight students. These data agree with those in the literature⁴⁰. Regarding HDL-C levels, despite the lack of a statistically significant association with BMI, the greatest percentage of low serum HDL-C levels was observed in degree II and III overweight individuals.

Diabetes mellitus is among the main causes of minor dyslipidemias. The Brazilian studies involving RF and AS analysis do not discuss diabetes mellitus, either by excluding diabetic individuals or by not making them present in

their samples. In this study, none of the students had fasting glycemia levels >126mg/dL.

In conclusion, it is appropriate to remember that studies aiming to characterize the risk profile of a population constitute the first step in elaborating preventive plans, allowing preventive measures to be adequate for the local reality in which they will be implemented, thus assuring their success. The present study draws attention to the elevated prevalence of RF for AS in adolescents and young adults. The involvement of the universities not only in the evaluation of the risk profile of their students but also in the educational process and the dissemination of the benefits of adopting a healthier life style would be very helpful in implementing a preventive plan for university students.

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