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Lipid profile and cardiovascular risk factors among first-year Brazilian university students in São Paulo

J. Costa Silva Zemdegs[1,2], L. Barreto Corsi[1], L. De Castro Coelho[1], G. Duarte Pimentel[2], A. Toyomi Hirai[1] and A. Sachs[1]

[1]Department of Preventive Medicine. Division of Nutrition. Federal University of São Paulo. Brazil. [2]Department of Physiology. Division of Nutrition Physiology. Federal University of São Paulo. Brazil.

Abstract

Background/aims: **The surveillance of cardiovascular risk factors has been recommended worldwide. The current study is aimed to estimate the prevalence of cardiovascular risk factors among first-year students from a public university in the city of Sao Paulo, Brazil.**

Methods: **A cross-sectional study of 56 first-year students, of both genders, was performed. Information about demographic characteristics, family history of chronic diseases, smoking, and physical activity was obtained by means of a standardised questionnaire. Anthropometrical parameters (BMI, waist circumference, body fat percentage), metabolic parameters (glycaemia, serum lipid profile), and dietary data (total energy intake, percentage of total energy from macronutrients, cholesterol and dietary fiber) were assessed.**

Results: **The risk of cardiovascular diseases was characterised by family history of cardiovascular diseases (44.6%), smoking (10.7%), physical inactivity (35.7%), borderline high total cholesterol and LDL-c levels (16.1% and 5.4, respectively), decreased HDL-c levels (8.9%), increased triglyceride levels (8.9%), and overweight and obesity (17.8% and 7.1%, respectively). The diet of the students was inadequate: it was high in fat and protein, and low in carbohydrate and dietary fibre.**

Conclusions: **The prevalence of risk factors for cardiovascular diseases in young adults draws attention to the need to adopt preventive plans in the university setting.**

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Key words: *Cardiovascular risk factors. Body mass index. Waist circumference. Cholesterol. Glycaemia. Young adults.*

Correspondence: Juliane Costa Silva Zemdegs.
Edificio de Ciências Biomédicas.
Rua Botucatu, 862 - 2º andar - Vila Clementino.
04023-062 São Paulo. Brazil.
E-mail: jzemdegs@unifesp.br

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PERFIL LIPÍDICO Y FACTORES DE RIESGO CARDIOVASCULAR EN ESTUDIANTES UNIVERSITARIOS BRASILEÑOS DE PRIMER ANO DE SAO PAULO

Resumen

Antecendentes/objetivos: **la vigilancia de los factores de riesgo se ha recomendado mundialmente. El presente estudio pretendía estimar la prevalencia de los factores de riesgo cardiovascular en estudiantes de primer año de una universidad pública de la ciudad de Sao Paulo, Brasil.**

Métodos: **Se realizó un estudio transversal de 56 estudiantes de primer año, de ambos sexos. Se obtuvo información acerca de las características demográficas, antecedentes familiares de enfermedades crónicas, hábito de fumar y actividad física mediante un cuestionario estandarizado. Se evaluaron parámetros antropométricos (IMC, circunferencia de la cintura, porcentaje de grasa corporal) y bioquímicos (glucemia, perfil lipídico en suero). La información relativa a la ingestión de la dieta se evaluó mediante un registro de alimentación de tres días.**

Resultados: **el riesgo de enfermedades cardiovasculares se caracterizó por los antecedentes familiares de enfermedades cardiovasculares (44,6%), hábito tabáquico (10,7%), actividad física (35,7%), colesterol y concentración de LDL-c en el límite superior (16,1% y 5,4, respectivamente), disminución de las concentraciones de HDL-c (8,9%), aumento de las concentraciones de triglicéridos (8,9%) u sobrepeso y obesidad (17,8% y 7,1%, respectivamente). La dieta de los estudiantes fue inapropiada: su contenido era elevado en grasas y proteínas y bajo en hidratos de carbono y fibra de la dieta.**

Conclusiones: **la prevalencia de factores de riesgo para enfermedades cardiovasculares en adultos jóvenes reclama la atención hacia la necesidad de planes preventivos en el ámbito universitario.**

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Palabras clave: *Factores de riesgo cardiovasclar. Índice de masa corporal. Circunferencia de la cintura. Colesterol. Glucemia. Adultos jóvenes.*

Introduction

Cardiovascular diseases remain the leading cause of death worldwide,[1] and in Brazil these diseases are responsible for more than 48% of the total number of deaths.[2]

Several risk factors for cardiovascular diseases have been identified, increasing the ability to prevent and manage chronic conditions. Risk factors for cardiovascular diseases comprise modifiable variables (smoking, sedentary lifestyle, inappropriate dietary habits, hypertension, hypercholesterolaemia, glucose intolerance, and obesity) and non-modifiable variables (age, gender, race, and heredity).[3]

Although cardiovascular diseases typically occur in middle age or later, risk factors for these diseases are determined to a large extent by the lifestyle behaviours learned early in life and maintained during adulthood.[4] In Brazil, in part due to changes in dietary habits and the degree of physical activity, a high prevalence of cardiovascular risk factors, particularly overweight and a sedentary lifestyle, have been reported among young adults.[2,5]

Given that several cardiovascular risk factors are modifiable, it is necessary to determine prevalence of these risk factors and, if the results warrant, to carry out prevention programs aimed at reducing their frequency. The aim of this study was to examine the prevalence of some of the main cardiovascular risk factors in a population of first-year students from a public university in a city in the southeast region of Brazil.

Methods

In the 2005 academic year, all first-year university students from a Brazilian public university, located in the city of Sao Paulo, were invited to take part in the present study. Fifty-six students pursuing career in the medical field (20% men, mean age 19.7 ± 0.9 years; and 80% women, mean age 20.6 ± 2.6 years) voluntarily participated in the study, representing 19% of the student population who entered the university that year. The study was approved by the Human Research Ethics Committee of the Federal University of Sao Paulo and all participants signed a consent form for participation in the protocol.

A standardised interview was carried out together with an anthropometric assessment by a team of expert nutritionists at the Student Health Services of the university. Through the standardised interview, information regarding family history of chronic diseases, regardless of the age of onset, as well as lifestyle habits such as smoking and physical activity were obtained. Smoking was classified in accordance of the Centers of Disease Control and Prevention[6] and the Brazilian Health Ministry.[7] Sedentary lifestyle was defined as being fewer than two weekly periods of physical activity with at least 30 minutes of duration.

Anthropometric assessment consisted of measurements of weight, height, waist circumference (WC) and skin folds, performed with the student in the standing position, barefoot, and in light garments. Weight and height were obtained by means of a scale bearing a stadiometer (Filizola®, model 31, São Paulo, Brazil). WC was obtained by means of a non-stretch fibreglass metric tape in the midline between the lower costal margin and the iliac crest. Body mass index (BMI) and WC were classified in accordance with the parameters of the World Health Organization.[8,9]. Four skin fold thickness were measured on the left side of the body, in triplicate, to the nearest 0.1 mm, by means of a Lange skin-fold calliper (Cambridge Scientific Industries, Inc.). The skin fold of the triceps was measured on the vertical fold; on the posterior midline of the upper arm (halfway between the acromion and olecranon processes, with the arm held freely to the side of the body). The biceps skin fold was also measured on the vertical fold, on the anterior aspect of the arm over the belly of the biceps muscle, 1 cm above the level used to mark the triceps site. The subscapular skin fold was taken from the diagonal fold at a 45° angle, 1 to 2 cm below the inferior angle of the scapula; and the suprailiac skin fold, also taken from the diagonal fold (in line with the natural angle of the iliac crest), was taken in the anterior axillary line immediately superior to the iliac crest. The body density was calculated from the sum of the four skin folds,[10] and the body fat percentage (%BF) was obtained and classified in accordance with Siri[11] and Lohman,[12] respectively.

Dietary data were evaluated by means of a non-consecutive three-day food record. Participants were provided with food record forms and were taught how to complete them. Total energy intake and percentage of total energy from macronutrients were obtained using the software NutWin® version 2.5 (Center for Health Informatics, Federal University of Sao Paulo, Sao Paulo, Brazil), and data were analysed in accordance with the recommendations of the World Health Organization[13] and the Institute of Medicine.[14]

Annually, all students are assessed for metabolic parameters at the Student Health Services of the university. In brief, blood samples were collected after overnight fasting by a team of nurses from the Central Laboratory of the Sao Paulo Hospital. Glycaemia was determined in plasma fluoride, and triglycerides, total cholesterol, and HDL-c were determined in serum by means of conventional laboratory enzymatic techniques. LDL-c and oxidised LDL-c levels were calculated using the equations of Friedwald et al.,[15] and Tsimihodimos et al.,[16] respectively. The metabolic parameters were analysed according to the definitions of the Brazilian Diabetes Society[17] and the National and International Cholesterol Education Program-NCEP/ ATPIII.[1] The prevalence of metabolic syndrome was assessed according to the NCEP/ATPIII[18] classification.

Statistical analyses were performed using the software GraphPad Prism, version 4.03 (GraphPad Soft-

Table I
Anthropometric and metabolic parameters of the university students according to gender

	Men		*Women*		
	Mean ± SD	*%*	*Mean ± SD*	*%*	*P*
Body Mass Index (kg/m²)	23.8 ± 2.8		22.9 ± 4.5		0.21 m
18.5-24.99		72.7		75.6	
25.0-29.99		27.3		15.6	0.50 fh
≥ 30.0		0.0		8.8	
Waist Circumference (cm)	79.8 ± 6.4		78.6 ± 9.8		0.35 m
< 94 (M); 80 (W)		100		68.8	
94-102 (M); 80-88 (W)		0.0		15.6 ≥	0.23 fh
102 (M); 88 (W)		0.0		15.6	
Body Fat (%)	17.9 ± 4.9		29.6 ± 6.2		< 0.001 m
≤ 19.9 (M); 24.9 (W)		63.6		17.8	
20.0-25.0 (M); 25.0-29.9 (W)		27.3		24.4	< 0.001 fh
≥ 25.1 (M); 30.0 (W)		0.0		57.8	
Fasting Glycaemia (mg/dL)	78.7 ± 9.8		73.4 ± 7.2		0.32 m
< 100		100		100	
Total Cholesterol (mg/dL)	141.4 ± 17.8		168.8 ± 29.9		< 0.001 m
< 200		100		80.0	0.18 f
200-239		0.0		20.0	
LDL-c (mg/dL)	84.1 ± 14.7		93.6 ± 23.6		0.08 m
< 100		72.7		75.6	
100-129		18.2		20.0	0.83 fh
130-159		9.1		4.4	
Oxidised LDL-c	2.54 ± 1.98		1.39 ± 0.55		0.05 m
< 3		100		100	
HDL-c (mg/dL)	38.9 ± 6.8		58.3 ± 10.9		< 0.001 m
< 40		45.5		0.0	< 0.001 f
≥ 40		54.5		100	
Triglycerides (mg/dL)	94.9 ± 50.4		79.7 ± 31.3		0.89 m
< 150		90.9		91.1	1.00 f
150-199		9.1		8.9	

Mann-Whitney test (m); Fisher exact test (f); Fisher-Freeman-Halton test (fh).

ware Inc., San Diego, USA). Descriptive analysis was carried out using means, standard deviations and percentages. The normality of the distributions was assessed using the D'Agostino-Pearson test. Comparisons between two variables were done using the Mann-Whitney test or the Kruskal-Wallis test for continuous variables and using the Fischer's exact test or the Fisher-Freeman-Halton test for the comparison of percentages. Correlations between anthropometric and metabolic parameters were determined using the Spearman correlation test. The level of significance was set at $p < 0.05$.

Results

A family history of dyslipidaemia was present in 18.2% of males and 44.4% of females; hypertension in 45.5% and 55.6% (respectively), diabetes mellitus in 54.5% and 71.1%, overweight/obesity in 45.5% and 44.4%, and cardiovascular disorders in 45.5% and 44.4%. None of the men and 13.3% of the women was smokers, and a sedentary lifestyle was presented in 27.3% of the men and 37.8% of the women, with no differences between genders in any of these variables.

Data regarding anthropometric and metabolic parameters of the students according to gender are summarised in Table 1. The mean values for BMI and WC were in the normal range for both men and women, with no difference between genders. However, according to the BMI classification, 27.3% of the men and 15.6% of the women were overweight, and 8.8% of the women were obese. Additionally, a WC associated with an increased risk of cardiovascular diseases was present in 31.2% of the women. The mean %BF levels were in the normal range for men, and they were mod-

Table II
Means and standard deviations of LDL-c and HDL-according to other cardiovascular risk factors

	LDL-c				*HDL-c*			
	Men		*Women*		*Men*		*Women*	
	Mean ± SD	*P*	*Mean ± SD*	*P*	*Mean ± SD*	*P*	*Mean ± SD*	*P*
Body Mass Index (kg/m²)								
18.5-24.99	82.3 ± 15.7	0.54 m	92.3 ± 25.6	0.53 m	40.13 ± 6.4	0.47 m	58.0 ± 10.9	0.98 m
≥ 25.0	88.3 ± 7.6		98.6 ± 18.1		36.0 ± 6.9		58.6 ± 11.8	
Waist Circumference (cm)								
≤ 94 (M); 80 (W)	84.1 ± 14.7	–	91.9 ± 20.8		38.9 ± 6.8	–	59.4 ± 10.8	
94-102 (M); 80-88 (W)	–	–	99.6 ± 17.3	0.39 k	–	–	55.3 ± 15.0	0.53 k
≥ 102 (M); 88 (W)	–		104.7 ± 19.4		–		58.1 ± 9.9	
Body fat (%)								
≤ 19.9 (M); 24.9 (W)	83.5 ± 15.2		104.0 ± 25.0		37.3 ± 7.3		55.5 ± 9.6	
20.0-25.0 (M); 25.0-29.9 (F)	92.3 ± 8.1	0.44 m	83.6 ± 12.1	0.08 k	44.0 ± 3.5	0.24 m	61.8 ± 12.2	0.58 k
≥ 25.1 (M); 30.0 (W)	–		100.2 ± 18.5		–		57.7 ± 9.4	
Sedentary Lifestyle								
Present	80.0 ± 24.0	0.52 m	88.0 ± 29.3	0.45 m	36.5 ± 4.9	0.58 m	58.6 ± 10.6	0.94 m
Absent	84.9 ± 12.8		96.6 ± 20.2		39.6 ± 6.9		58.2 ± 11.3	
Smoking								
Present	–	–	95.8 ± 20.9	0.81 m	–	–	54.8 ± 13.5	0.37 m
Absent	84.1 ± 14.7		93.3 ± 24.3		38.9 ± 6.8		58.9 ± 10.6	

Mann-Whitney test (m); Kruskal-Wallis test (k).

erately high for women. The mean %BF levels were significantly higher in women than in men (P = < 0.001) and an increased %BF was observed in 57.8% of the women.

The mean fasting glycaemia levels were in the normal range for both men and women and did not differ between genders. A significant alteration in fasting glycaemia concentration was observed in neither gender.

Mean total cholesterol, LDL-c, oxidised LDL-c, HDL-c and triglycerides levels were in the normal range for both genders. Women presented mean total cholesterol and HDL-c levels that were higher than those of the men (P < 0.001), mean LDL-c levels tended to be higher in the women (P = 0.08), and mean oxidised LDL-c levels were higher in men than in women (P < 0.001). Dyslipidaemias, characterised by increased levels of total cholesterol, LDL-c and triglycerides were not observed in the present sample. However, borderline high total cholesterol levels were observed in 20.0% of the women, borderline high LDL-c levels were observed in 9.1% of the men and 4.4% of the women and borderline high triglycerides levels were observed in 9.1% of the men and 8.9% of the women, with no difference between genders. Additionally, reduced HDL-c levels were observed in 45.5% of the men and none of the women. Tables 2 and 3 show the mean levels of the metabolic parameters, according to the other cardiovascular risk factors analysed. In the present sample, it was not able to observe any statistically significant associations between the metabolic parameters and the other cardiovascular risk factors. Importantly, BMI showed a directly proportional relation to WC (P < 0.001), BF% (P < 0.001), total cholesterol (P = 0.04), LDL-c (P = 0.01), and triglyceride levels (P = 0.04). Based on the parameters evaluated, i.e., WC, fasting glycaemia, HDL-c, and triglycerides levels, no men or women had metabolic syndrome.

Dietary data according to gender are shown in Table 4. Energy intake was statistically higher in the male students than in the female students (P < 0.001). The mean carbohydrate intake was below the adequate range, whereas the mean protein and lipid intakes were above recommended levels in both men and women, with no difference between genders. In both genders, the mean cholesterol and fibre intakes were, respectively, in the normal range and below the recommended range. No statistically significant difference in the average intake of these nutrients was observed between genders.

Discussion

Epidemiological trends indicate that there will be an increase in incidences of cardiovascular diseases worldwide, particularly in developing countries.[3,19,20] Accordingly, the incidence of cardiovascular risk factors has increased among Brazilians in recent years, and mortality from cardiovascular diseases remains the

Table III
Means and standard deviations of serum total cholesterol, triglycerides and glycaemia according to other cardiovascular risk factors

	Total cholesterol				*Triglycerides*				*Glycaemia*			
	Men		*Women*		*Men*		*Women*		*Men*		*Women*	
	Mean ± SD	*P*	*Mean ± SD*	*P*	*Mean ± SD*	*P*	*Mean ± SD*	*P*	*Mean ± SD*	*P*	*Mean ± SD*	*P*
Body Mass Index (kg/m²)												
18.5 - 24.99	137.7 ± 18.1	0.54	167.0 ± 32.3	0.50	74.83 ± 27.4	0.71	77.5 ± 32.7	0.21	76.6 ± 9.9	0.76	73.3 ± 7.9	0.98
≥ 25.0	147.7 ± 14.7	m	174.8 ± 23.7	m	116.7 ± 81.4	m	87.6 ± 28.4	m	79.0 ± 13.9	m	73.9 ± 6.0	m
Waist Circumference (cm)												
< 94 (M); 80 (W)	141.4 ± 17.8		167.5 ± 28.8	0.70	94.9 ± 50.4		76.9 ± 35.9	0.42	78.7 ± 9.8			0.35
94-102 (M); 80-88 (W)	–	–	163.3 ± 45.4	k	–	–	86.2 ± 20.5	k	–	–		k
≥ 102 (M); 88 (W)	–		179.9 ± 20.7		–		85.1 ± 29.3		–			
Body fat (%)												
≤ 19.9 (M); 24.9 (W)	141.2 ± 17.6	0.30	175.0 ± 34.2	0.23	112.3 ± 67.4	0.63	78.5 ± 36.9	0.19	76.7 ± 7.7	0.60	73.7 ± 7.0	0.42
20.0-25.0 (M); 25.0-29.9 (W)	151.7 ± 8.1	m	157.8 ± 23.4	k	76.0 ± 29.5	m	62.1 ± 17.8	k	84.0 ± 15.1	m	76.4 ± 7.0	k
≥ 25.1 (M); 30.0 (W)	–		175.8 ± 27.1				88.7 ± 38.3		–		71.7 ± 7.3	
Sedentary Lifestyle												
Yes	135.5 ± 33.2	0.60	167.8 ± 23.1	0.73	95.0 ± 18.4	0.52	71.2 ± 21.6	0.30	80.5 ± 7.8	0.37	71.9 ± 8.6	0.32
No	141.6 ± 14.9	m	169.5 ± 33.2	m	87.0 ± 37.8	m	84.1 ± 34.8	m	76.6 ± 11.2	m	74.3 ± 6.4	m
Smoking												
Yes	–	–	161.2 ± 58.8	0.78	–	–	104.0 ± 49.1	0.16	–	–	75.0 ± 4.3	0.50
No	141.4 ± 17.8		170.1 ± 24.3	m	94.9 ± 50.4		75.7 ± 26.3	m	78.7 ± 9.8		73.3 ± 7.5	m

Mann-Whitney test (m); Kruskal-Wallis test (k).

leading cause of death in Brazil.[2] The reversal of this situation requires the adoption of preventive measures, which has been extensively shown to be effective in modifying cardiovascular risk factors.[21,22] In view of this, the identification of groups with risk factors for cardiovascular diseases is essential for the development of effective preventive plans.

In agreement with national and international literature, the data from the present study shows a considerable prevalence of cardiovascular risk factors among young adults. A family history for chronic diseases was reported by many of the university students. Several studies have revealed a greater prevalence of cardiovascular risk factors in relatives of individuals with cardiovascular diseases and type 2 diabetes mellitus, when compared with those without family history of these diseases.[23,24]

An important prevalence of smoking and sedentary lifestyle has been reported in Brazilian young adults,[25,26] and in the present sample as well. Smoking is one of the greatest risk factors for cardiovascular diseases, and even in young people, a relationship between serum lipoprotein cholesterol concentrations and smoking has been reported.[27] A sedentary lifestyle has been shown to be an independent risk factor for cardiovascular diseases.[3,28,29] Currently, computers occupy a great part of the students' time, and this habit has been shown to be negatively associated with physical activity.[30] Additionally, the possible reduction in extracurricular activities after entering university might have contributed to the elevated frequency of a physical inactivity.

Anthropometric variables have extensively been shown to predict cardiovascular risk.[31] A considerable prevalence of overweight and obesity, particularly in women, was observed among university students. Accordingly, some of the women presented abdominal obesity, as measured by WC, and a higher %BF than men did. Our results show a higher prevalence of a BMI > 25 kg/m² than that reported in young adults from Brazil,[25,26,32] and a similar prevalence to studies conducted in developed countries.[33,34]

In the present sample, undesirable levels of serum total cholesterol, LDL-c and triglycerides were observed in both genders. Alterations in the lipid profile have been extensively shown to be important in determining the development of cardiovascular diseases, and the lipid profile has also been shown to be related to the indices of mortality due to cardiovascular diseases.[18,35-37]

Diet is considered one of the most important modifiable variables involved in the determination cardiovascular risk.[37-40] The diet composition of the university students was found to be low in carbohydrates and high in proteins and lipids. Along with inadequate diet composition, all students reported a low dietary fibre intake. This profile is similar to that found in developed societies and features part of the nutritional transition, which has spread to the developing countries.[5,41]

Table IV
Energy and nutrient intake of the university students according to gender

	Men		*Women*		
	Mean ± SD	*%*	*Mean ± SD*	*%*	*P*
Energy (kcal)	2,940 ± 829.5		2,131.2 ± 527.4		< 0.001 m
Carbohydrate (% E)	46.9 ± 13.4		52.1 ± 10.1		0.10 m
< 55.0%		81.8		53.3	0.10 f
55.0-75.0%		18.2		46.7	
Protein (% E)	17.2 ± 3.2		15.9 ± 3.2		0.17 m
10.0-15.0%		36.4		37.8	1.00 f
> 15.0%		63.6		62.2	
Lipid (% E)	36.0 ± 14.3		32.0 ± 9.2		0.15 m
15.0-30.0%		36.4		37.8	1.00
> 30.0%		63.6		62.2	
Cholesterol (mg)	188.8 ± 85.7		197.8 ± 44.6		0.43 m
< 300 mg/d		100		100	
Fibre(g)	14.7 ± 5.3		11.8 ± 5.6		0.25 m
< 25.0 g/d		100		100	

% of Energy (% E); Mann Whitney test (m); Fisher exact test (f).

Despite the frequency of students with undesirable serum lipids and inadequate diet composition, we were unable to observe any association between serum parameters, dietary data and the other cardiovascular risk factors. Intra-individual variability, both in the diet and in serum parameters, have been shown to reduce the possibility of detecting the presence of associations in one population, i.e., associations are clearer in studies aiming to compare different populations.[42] On the other hand, in this study, BMI showed a directly proportional relationship with serum total cholesterol and LDL-c levels. The greater the BMI, the greater the prevalence of higher than desired values for these parameters, which indicates the importance of this simple and inexpensive anthropometric evaluation.

To sum up, an important prevalence of cardiovascular risk factors was observed in the university students included in the present study. Considering that some of the cardiovascular risk factors are modifiable by changes in lifestyle, educational programs aimed at motivating the adoption of healthy lifestyle choices would be helpful, especially in upcoming health care professionals, as it is them who will be taking care of the health of the population in the future.

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