Original Article

Cardiovascular Health Profile of an Adult Population from the Metropolitan Region of São Paulo

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Objective

To describe the cardiovascular health profile of an adult population from the metropolitan region of São Paulo, according to the European Society of Cardiology (ESC) criteria.

Methods

Two hundred volunteers of both sexes enrolled in the "Cardiac Evaluation" project of a general outpatient clinic were studied. Data collected included socioeconomic status, cigarette smoking, alcohol consumption, anthropometric measurements, diet, physical activity, serum lipids, blood glucose and blood pressure. Average intake of dietary cholesterol and total lipids was estimated from a 24-hour dietary recall. Physical activity level was assessed using the International Physical Activity Questionnaire (IPAQ-8) and exercise stress tests.

Results

Sample population composition was 61.5% female and 38.5% male, mean age 41.7 (median = 42.6) and 41.0 (median = 43.0%). Prevalence of smoking (22%) and daily alcohol consumption (14% males; no females) was low. The overweight prevalence was 47% (12% being obese), in addition to high levels of serum total cholesterol (≥ 190 mg/dl) in 56% and LDL-cholesterol (≥ 115 mg/dl) in 61%. The IPAQ-8 results showed that 6% were sedentary.

Conclusion

The study population showed greater risk of cardiovascular diseases, according to ESC criteria, due especially to the high prevalence of overweight and hypercholesterolemia.

Key words

Cardiovascular health, adults, risk factors.

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Cardiovascular diseases are the leading cause of morbidity and mortality in Brazil (300.000 deaths/year), accounting for 34% of deaths in the city of São Paulo[1,2].

According to Lotufo[3,4], ischemic heart diseases predominate over cerebrovascular diseases in the state of São Paulo, compared with the rest of the country, which may be attributed to urbanization and adoption of Western lifestyles as well as the ethnic composition of São Paulo state population.

During the last decade, epidemiologic studies on risk factors for cardiovascular diseases were performed in metropolitan regions of Brazil[5-10], most of them based on preventive measures proposed by the American Heart Association (AHA) guidelines[11]. However, there are no references to Brazilian papers based on recommendations made by the European Society of Cardiology (ESC)[12] in 1998, which like as those of AHA's, are based on the control of major known risk factors, such as: smoking, obesity, dyslipidemias, diabetes mellitus, arterial hypertension, poor diet, and physical inactivity.

Analysis of risk factor prevalence in populations using different approaches is an interesting practice that may generate relevant information for the development and reevaluation of national guidelines designed to address the unique characteristics of each population.

The present study corresponds to the secondary purpose of a survey primarily focused on the development of a Food Frequency Questionnaire (FFQ) devised to investigate relationships between nutrition and non-communicable chronic diseases in different adult populations of Brazilian metropolitan regions[13,14]. Using the parameters proposed by ESC in 1998, this article reports the results of cardiovascular risk factor profile of subjects with no previous diagnosis of heart disease that live in the metropolitan region of São Paulo.

Methods

In 2002, a cross-sectional study was conducted in a general outpatient clinic in the city of São Paulo.

The study population was selected among adult subjects who participated in the Cardiac Evaluation cohort first developed at the General Outpatient Clinic in 1997.

The Cardiac Evaluation study is intended to follow up on male and female subjects, age 18 and above, with no cardiac symptoms nor history of heart disease, who visit the General Outpatient Clinic for a check-up and show normal physical and cardiac examinations, such as stress and resting electrocardiogram, chest radiography and echocardiography.

Patients of the General Outpatient Clinic are adults, live in the city of São Paulo and represent a broad range of socioeconomic levels. Most of these patients (42%) are referred by the Hospital das Clínicas of the University of São Paulo (USP); however, about 14% present themselves voluntarily for cardiac evaluation[15,16].

Patients who met the following criteria were included in the study: a) men and women, age 18 and above; b) normal cardiac examination, ECG, chest radiography, exercise stress testing, and echocardiogram.

Patients who met the following criteria were excluded from the study: a) history of cardiovascular disease or cardiac symptoms; b) chronic diseases, such as chronic obstructive pulmonary disease, asthma, hypertension, chronic inflammatory diseases, osteoarticular diseases, diabetes, renal diseases, neoplasias and Chagas' disease; c) fasting plasma glucose > 110 mg/dl measured on two different occasions.

As already stated, this study was part of a survey aiming at the development of a FFQ for the adult population of Brazilian metropolitan regions[13,14]. A number of studies have demonstrated that samples comprising 150 to 200 subjects allow the development of tools (FFQ) capable of producing acceptable validity and reproducibility results whenever tested[17-20].

Therefore, in 2002, two hundred subjects of both sexes randomly selected from the Cardiac Evaluation project were invited to participate in this study.

Cardiovascular health profile evaluation

The proposed ESC recommendations[12] are thoroughly described in chart 1. Data on cardiovascular risk factors established by ESC were collected from questionnaires filled out during personal interviews and from clinical data.

Each and every participant completed a standard questionnaire covering socioeconomic status and lifestyle, including schooling, marital status, ethnicity, occupation, family income, smoking, and alcohol consumption.

A 24-hour dietary recall was administered to every subject to gather information on food and beverage consumption within the previous 24 hours. Questions about fruit and vegetable intake were added to the 24-hour dietary recall.

Physical activity level was assessed, using the International Physical Activity Questionnaire (IPAQ-8, short version). IPAQ is a questionnaire proposed by the World Health Organization to assess physical activity worldwide and is currently being used in 12 countries[21]. In Brazil, the IPAQ-8 questionnaire was validated against results derived from a motion sensor, the *Computer Science & Applications* (CSA), with a Spearman's correlation coefficient of $r = 0.69$ ($p < 0.01$)[22]. This questionnaire includes questions about duration and intensity of physical activity on a "usual" week in occupational, transport, leisure or sports activities.

To assess physical activity level, we analyzed the answers collected from the questionnaire based on ESC recommendations, that is, active individuals are defined as those who get at least 30 minutes of physical

Chart 1 - European Society of Cardiology (ESC, 1998) recommendations for prevention of Cardiovascular Diseases, according to the characteristic to be observed

Personal characteristics	Biochemical an physiological characteristics	Lifestyle characteristics
Age Men > 55 Women > 65	Blood pressure Systolic > 140 mm Hg Diastolic > 90 mm Hg	Physical inactivity Physical activity < 30 min/day at least twice a week
Gender Male	Lipid profile Total cholesterol > 190 mg/dL	Smoker
Family history of premature cardiovascular disease Men < 55 years Women < 65 years	LDL-cholesterol > 115 mg/dL HDL-cholesterol > 40 mg/dL Triglycerides >180 mg/dl	Excess alcohol consumption Men > 30 g/day Women > 20 g/day
Personal history of cardiovascular disease	Fasting plasma glucose >110 mg/dl	Daily intake total fats > 30% calories saturated fats > 10% calories cholesterol > 300 mg salt > 6g fish, fruits, and vegetables

Adapted from ESC recommendations, 1998

activity per day for a minimum of 2 days a week, and sedentary individuals, as those who get less than 30 minutes of physical activity once a week or no physical activity at all.

Clinical data, anthropometric assessment, body mass index (BMI) – In order to determine body mass index (BMI), anthropometric assessment was performed on each subject. Body weight was measured using a digital scale with maximum capacity of 150 kg and 100g tolerance, and height was measured by a portable stadiometer, with the subject standing erect, looking straight ahead and keeping heels together.

Body mass index was calculated from the formula BMI = weight/(height)^2.

Waist circumference (WC) was measured using a steel tape measure at the narrowest point between the lowest rib and the iliac crest (three measurements on average)[23].

As part of check-up examinations, all participants of the Cardiac Evaluation project had their systemic blood pressure measured, as well as serum lipid and glucose levels.

Physical capacity was also assessed based on exercise stress test results. Exercise capacity can be expressed in multiples of metabolic equivalents - METS, which represent the normal oxygen consumption at rest, defined as 3.5 ml/min/kg of body weight[24,25]. In the General Clinic, where the study was conducted, the Ellestad protocol is commonly used for exercise stress testing[26].

Exercise stress test results were translated into risk indicators, owing to its prognostic value for the development of cardiovascular diseases For this purpose, the cut-off points proposed by Morris et al [27]were used. Accordingly, exercise capacity less than 6 METS reached during the examination indicated high risk for cardiovascular diseases, from 6 to 9.9 METS indicated moderate risk, and 10 METS or greater represented protection.

STATA software (version 6.0) was used to create a database and analyze data[28].

First, distribution of all continuous variables was examined to determine whether it followed a Gaussian distribution. Data on socioeconomic variables, such as age, gender, occupation, schooling, income, place of birth, and ethnic group were descriptively analyzed through measures of central tendency and dispersion, such as mean, median, and standard deviation.

Food items collected from the 24-hour dietary recalls were converted into nutrients using the Virtual Nutri software [29] and, later, current average intake of total fats, dietary cholesterol, salt, fruits, vegetables, and fish of the study population was analyzed[13,14].

Finally, as part of the descriptive analysis of the population, Student's t test was used to compare two means for possible gender-related differences regarding main cardiovascular risk factors, such as BMI, lipid profile, blood glucose and blood pressure, as well as total fat, salt, and dietary cholesterol intake, at a 5% significance level.

Associations between BMI and clinical and laboratory examination results, fat and cholesterol intake plus physical activity were studied using the X^2 test for association (chi-square) at a 5% significance level. Associations between smoking and alcohol consumption and lipid profile were also analyzed.

Results

Although two hundred volunteers participated in this study, six (3%) patients who had undergone neither exercise stress test nor lipid profile and blood glucose measurements were excluded from the statistical analyses involving these variables.

Study sample comprised 123 (61.5%) female and 77 (38.5%) male subjects, mean age 41.7 (median = 42.6) and 41.0 (median = 43.0), respectively. The population studied was predominantly white (75%), with a small percentage of blacks (4.5%) and Asians (3.5%). Approximately 37.5% were high school graduates or had some college education (12 or more years of schooling). Approximately 75% of the men and 52% of the women were active workers.

Table 1, based on ESC recommendations, shows cardiovascular health indicators distribution in the population studied according to gender.

Thirty percent of the men and 17% of the women were current smokers ($p = 0.034$), while 21% of both genders were former smokers. More than half of the participants, 49% of the men and 62% of the women, had never smoked. A statistically significant increase in smoking prevalence among older subjects was observed (chi-square test = 10.8; $p = 0.013$), and the majority of smokers (34%) were in the age group at greatest cardiovascular risk, between 50 and 65 years of age.

Most participants reported not drinking alcohol on a regular basis: about 41% of the men drank once or twice a week, and 58% of the women, only on special occasions.

Overall, our study population showed a high degree of overweight (BMI = 25-29.9 kg/m^2) and obesity (BMI ≥ 30.0 kg/m^2), which increased with age group ($p = 0.011$) and was most prevalent in the 40-49 and 50-65 age groups. Mean BMI for men was 25.0 kg/m^2 (median = 24.2) and for women, 25.4 kg/m^2 (median = 24.8). BMI was not associated with either gender or socioeconomic levels. Table 2 shows BMI mean, median, plus minimum and maximum values, according to the different age groups of the study population.

Average intake of total fats (around 30% of all energy expended) and dietary cholesterol (236 mg for men and 183.9 mg for women) was within the parameters recommended by ESC. Forty per cent of the study population exceeded the daily limit of salt intake, mostly men ($p = 0.011$). Only 49% were getting the right amount of fruits and vegetables in their daily diets, but no participant was getting the right amount of fish.

As far as laboratory results are concerned, it was found that 67.6% of the men had serum total cholesterol greater than 190 mg/dL, associated with smoking ($p = 0.035$), and that cholesterol levels rose with increase in age group ($p = 0.002$) and BMI ($p = 0.013$).

The European Society of Cardiology (1998) also proposes that LDL-cholesterol levels equal to or greater than 115 mg/dL may increase cardiovascular risk. In our study population, mean LDL-cholesterol levels were 130.6 mg/dL for men and 127.5 mg/dL for women, and no statistically significant differences were found between genders ($p = 0.554$).

A statistically significant inverse association was detected between HDL-cholesterol levels greater than 40 mg/dL and BMI ($p < 0.001$). Serum HDL-cholesterol levels less than 40 mg/dL were significantly associated with smoking ($p = 0.009$) and with low exercise capacity measured by exercise stress test ($p = 0.008$).

Physical activity analysis, based on the answers to the IPAQ-8 questionnaire, showed that only 4.5% of the men and 6.5% of the women could be considered sedentary, that is, 95.5% of the men and 93.5% of the women were engaged in some protective activity according to ESC criteria (less than 5 days a week for less than 30 minutes).

With regard to exercise stress tests, mean exercise capacity was 10.0 METS (median = 11.2) for men and 9.1 METS (median = 9.02) for women, a statistically significant difference between means of the genders ($p = 0.008$).

It was noted that 60.8% of the men and 45% of the women had exercise capacity equal to or greater than 10 METS (Table 3), indicating some protection against cardiovascular diseases; no statistically significant differences were found between genders ($p = 0.092$), only among age groups ($p = 0.011$).

Discussion

Distribution by age and ethnic group in our population was very similar to the reality of the city of São Paulo, according to data from the most recent census carried out by IBGE, the Brazilian Institute of Geography and Statistics[30]. However, socioeconomic level and schooling were slightly higher than those reported by IBGE[30].

Patients in our study were randomly selected among those who presented themselves voluntarily to the General Outpatient Clinic to participate in the cardiac check-up program. The voluntary nature of study participation may explain the number of women and the socioeconomic level being higher than those reported by IBGE[30], because people concerned about their health and who choose to have a check-up are often women with higher cultural and socioeconomic status and broader access to information.

Female predominance may also be due to the fact that 48% of the study participants were not active workers, but homemakers (17%), unemployed (25%) and retired (6%), unlike most of male subjects (75%), who were active workers. This same predominance was observed in other studies conducted at the Incor General Outpatient Clinic, such as that by Yamada et al[16], in which prevalence was 56% women and 44% men. Araújo et al[31], in a more recent study conducted at the Incor General Outpatient

Table 1-Cardiovascular health of the population studied. by gender and according to ESC recommendations. São Paulo. Brazil. 2002

Risk Factors	Frequency			
	Male		Female	
	n	%	n	%
	77	38.5	123	61.5
Age ≥ 55	8	10.4	14	11.4
Current smoke	23	29.9	21	17.1
Drink alcohol daily	64	83.2	79	64.2
BMI ≥ 25 kg/m^2	35	45.5	60	48.8
WC men ≥ 94cm women ≥ 80cm	31	40.3	81	65.8
Sedentarism (IPAQ)	5	4.5	8	6.5
**Exercise stress test < 6 METS	8	10.8	18	15.0
**SBP ≥ 140 mm Hg	10	13.5	13	10.8
**DBP ≥ 90 mm Hg	16	21.6	14	11.7
**Cholesterol > 190 mg/dL	50	67.6	59	49.0
**LDL-cholesterol > 115 mg/dL	48	64.8	71	59.2
**HDL-cholesterol > 40 mg/dL	14	18.9	17	14.2
**Triglycerides > 180 mg/dL	16	21.6	7	5.8
**Blood glucose > 110 mg/dL	4	5.4	5	4.2
**Dietary cholesterol > 300 mg/dL	23	29.5	21	17.2
Salt > 6g	39	52.0	42	34.3
Fats > 30% total kcal	21	34.7	51	41.8

*** Statistical analyses performed for 194 subjects. BMI – body mass index; WC – waist circumference; SBP – systolic blood pressure; DBP – diastolic blood pressure*

Table 2 – BMI distribution, means, medians plus maximal and minimum values, according to age groups. São Paulo, Brazil, 2002

	BMI (Kg/m$^{2)}$					
Age group (years)	**n**	**%**	**mean**	**median**	**min**	**max**
	200	(100.0)				
20-29	42	(21.0)	23.3	22.9	18.7	30.4
30-39	40	(20.0)	24.5	24.1	16.6	37.0
40-49	71	(35.5)	21.6	21.3	18.5	39.9
50-65	47	(23.5)	25.7	25.5	19.3	35.2

**BMI evaluated according to categories proposed by WHO (1997). ANOVA p = 0.001*

Table 3 – Exercise capacity (METS) of the population studied, according to cardiovascular risk and by gender. São Paulo, 2002

Exercise capacity*	**Men**		**Women**	
	n=74	(%)	**n=120**	**(%)**
High risk ≤ 6 METS	7	(9.5)	19	(15.8)
Moderate risk 6.1 – 9.9 METS	22	(29.7)	47	(39.2)
Protection ≥ 10 METS	45	(60.8)	54	(45.0)

**Results categorized according to Morris et al (1991): exercise capacity less than 6 METS = high cardiovascular risk; from 6 to 9.9 METS = moderate risk; equal to or higher than 10 METS = protection*

Clinic, also found a prevalence of women over men, 57% and 43%, respectively.

Overall, the smoking rate in our population (22%) was lower than that found in other studies performed in Brazilian urban areas, such as those by Cardoso et al[7], Neumann[32] and Nogueira et al[33], with rates of 35%, 27% and 38%, respectively.

Our population consisted of subjects who went to a medical center because they wanted to undergo a preventive cardiac evaluation and, therefore, may be more health-concious; hence, the smal number of smokers. This phenomenon is known in epidemiology as the *Healthy Effect* of volunteers.

The European Society of Cardiology recommends that alcohol consumption does not exceed 30g/day for men and 20g/day for women. One of the limitations of our study, however, was the inability to quantify alcohol consumption, since only weekly alcohol intake was assessed due to the nutritional assessment tool used, the 24-hour dietary recall. Therefor, although daily alcohol use was reported by 14% of the participants, all of them males, alcohol intake in our population may have been underestimated. Nevertheless, despite this limitation regarding alcohol consumption frequency, our results were similar to those found in a study performed in the city of Porto Alegre, in which 14% of the men and women were daily alcohol users[10].

The majority of the study population showed BMI and waist circumference levels above those recommended by ESC. Overweight and obesity are a growing problem throughout the Western world and already a reality in Brazil[34,35]. In 1997, obesity rates in this country, according to nutritional investigations, were 8.0% for men and 12.4% for women in the Southeast and 4.7% for men and 12.3% for women in the Northeast.[34]

Overweight prevalence in Brazil, defined as BMI ≥ 25 kg/m², for the year 2000 was estimated at 47.4% for men and 44.2% for women; for 2005, it was anticipated that 57.5% of the men and 44.9% of the women would have some degree of overweight or obesity[35]. Our findings seem to corroborate these estimates, and they are higher than rates of overweight and obesity observed in Brazilian metropolitan areas by authors such as Neumann[32] and Cardoso et al[7], of 35% and 39%, respectively.

In a study conducted with Petrobras employees in 2004, Rio de Janeiro, *Matos* et al[36] found total cholesterol levels higher than normal (borderline high and high) in 56.6% of the subjects, 19.3% exceeding 240 mg/dL. With respect to lipid profile, more than half of study subjects showed serum total cholesterol and LDL-cholesterol levels higher than those recommended by ESC, and a statistically significant association was found with other cardiovascular risk factors, such as BMI and smoking. These results are similar to those found by Matos et al[36] and higher than those found in other studies performed in Brazilian urban areas.[5,10,32,33] However, the majority of our population showed HDL-cholesterol levels within those recommended by ESC as protective, as well as others found in Rio de Janeiro.[36]

In our population, prevalence of hypertriglyceridemia, hyperglycemia and hypertension was lower than that observed in other studies conducted in Brazilian cities[5,9,10,32,33]. It should be kept in mind that among exclusion criteria were subjects previously diagnosed with diabetes and hypertension, which may explain this low prevalence.

As for physical activity, 8.7% of our population was classified as sedentary, according to the IPAQ results, a much lower rate than that found in a study performed with adults from the São Paulo metropolitan region. Using a five-item questionnaire, this study found 39% of the people physically inactive[37]. Another study found a 60% sedentary prevalence among employees of a state bank in the City of Rio de Janeiro, using another questionnaire and defining as cut-off point for sedentarism less than 20 minutes of physical activity and less than 2 times per week.[38]

In a study performed in the northeastern and southeastern regions of Brazil, using a six-item questionnaire, only 3.5% of individuals from the Southeast met the recommended minimum of 30 minutes of physical activity at least 5 days a week between 1996-1997.[39] Around 64.8% of participants were considered sedentary. As this study took into account only sports and recreational activities performed during leisure time, the number of inactive people may have been overestimated by up to 20%[39].

In our study, the IPAQ-8 elicited information on occupational and household activities, which were used for classifying the level of physical activity. Some male participants said that their jobs involved high-energy expenditure (mechanics, bricklayers), and 17% of the interviewed women were “homemakers” and did domestic services daily.

When comparing our findings with those of a recent study performed to assess physical activity level of subjects from 29 cities of São Paulo State[40] using the IPAQ-8, we observed that sedentary prevalence was even lower than the approximate 6% found in our study conducted in the São Paulo metropolitan region, using the same cut-off points[21].

Based on the exercise stress test results, it was found that exercise capacity of 39% of the men and 55% of the women was less than 6 METS, which points to a sedentary or high cardiovascular risk population. These findings were a surprise to the authors of this study, since they highly disagreed with those reflected by the IPAQ-8, in which only 8.7% of subjects were classified as sedentary, that is, 79.4% were physically active and were protected against cardiovascular diseases, contrary to these exercise test results.

This study was not designed to develop a predictive model of cardiovascular risk and, therefore, its findings are essentially exploratory. However, they suggest that part of the population studied are at high risk for developing cardiovascular diseases, particularly due to the high BMI, serum total cholesterol and LDL-cholesterol levels.

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

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