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Prevalence of cardiovascular risk factors, the association with socioeconomic variables in adolescents from low-income region

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Abstract

***Objectives*: To estimate the prevalence of obesity, overweight, abdominal obesity and high blood pressure in a sample of adolescents from a low-income city in Brazil and to estimate the relationship with the socioeconomic status of the family, the education level of the family provider and the type of school.**

***Methods*: This cross-sectional study randomly sampled 1,014 adolescents (54.8% girls), between 14-19 years of age, attending high school from Imperatriz (MA). The outcomes of this study were: obesity and overweight, abdominal obesity and high blood pressure (systolic and/or diastolic). The independent variables were: socioeconomic status (SES) of the family, education level of the family provider (ELFP) and type of school. The confounding variables were: gender, age and physical activity level. Prevalence was estimated, and the association between the endpoints and the independent variables was analyzed using a prevalence ratio (PR), with a 95% confidence interval, estimated by Poisson regression.**

***Results*: The overall prevalence of obesity was 3.8%, overweight, 13.1%, abdominal obesity, 22.7% and high blood pressure, 21.3%. The adjusted analysis indicated that girls with high SES showed an increased likelihood to be overweight (PR=1.71 [95% IC: 1.13-2.87]), while private school boys had an increased likelihood of obesity (PR=1.79 [95% CI: 1.04-3.08]) and abdominal obesity (PR =1.64 [95% CI: 1.06-2.54]).**

***Conclusion*: The prevalence of CVDR is high in adolescents from this low-income region. Boys from private**

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PREVALENCIA DE FACTORES DE RIESGO CARDIOVASCULAR, LA ASOCIACIÓN CON LAS VARIABLES SOCIOECONÓMICAS EN LOS ADOLESCENTES EN REGIÓN DE BAJA RENTA

Resumen

***Objetivos*: Estimar la prevalencia de obesidad y sobrepeso, obesidad abdominal y hipertensión arterial en una muestra de adolescentes pertenecientes a una ciudad de baja renta en Brasil y su relación con el nivel socioeconómico, nivel educativo de lo responsable de la familia y tipo de escuela.**

***Métodos*: Estudio transversal con una muestra de 1014 adolescentes (54,8% chicas), con edades entre 14-19 años, estudiantes de las escuelas de la ciudad de Imperatriz (Brasil), seleccionadas por un muestreo aleatorio. Las variables dependientes evaluadas son: obesidad general y sobrepeso, obesidad abdominal, y tensión arterial alta (sistólica y/o diastólica). Las variables independientes son: nivel socioeconómico de la familia (NSO), el nivel de educación de lo responsable de la familia (NERF) y tipo de escuela. Las variables de confusión son: sexo, edad y nivel de actividad física. La prevalencia fue estimada, y la asociación entre las variables dependientes y las variables independientes se analizaron mediante razón de prevalencia (RP), con intervalo de confianza (IC) del 95%, estimado por la regresión de Poisson.**

***Resultados*: La prevalencia de la obesidad general fue de 3,8%, sobrepeso 13,1%, obesidad abdominal 22,7% y la tesión arterial alta 21,3%. Las análisis ajustadas indicaron que las chicas con NSO alto tienen mayor probabilidad de tener sobrepeso (RP=1,71 [IC95%: 1,13 a 2,87]), y chicos de las escuelas privadas tienen más probabilidad de tener obesidad (RP=1,79 [IC95%: 1.04-3,08]) y obesidad abdominal (RP=1,64 [IC95%: 1,06 a 2,54]).**

***Conclusión*: La prevalencia de los FRC es alta en adolescentes de una región de baja renta. Los chicos de las escuelas privadas son más propensos a tener obesi-**

schools are more likely to have obesity and abdominal obesity, and girls with high SES are more likely to be overweight.

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Palabras clave: *Adolescentes. Factores de Riesgo Cardiovascular. Baja Renta.*

Introducción

Cardiovascular diseases (CVD) are the leading cause of death worldwide, according to Pan-American Health Organization[1]. The literature provides strong evidence that the risk factors for CVD begin to develop during childhood and adolescence[2,3] and tend to remain[3] throughout life[4]. High blood pressure is a major risk factor for CVD development, as it is present in 40.6% of CVD cases[5], and is directly associated with excess body weight (obesity and overweight)[6,7] and abdominal obesity[8] in adults[9].

Cardiovascular risk factors are associated with socioeconomic, sociodemographic and behavioral factors[3,10,11] and may be regulated by physical activity[7,12,13]. When compared to developed countries[15], adolescents[12] in developing countries (including Brazil) have a high prevalence of cardiovascular risk factors[14], which have been shown to be associated with the lower economic classes[16,17]. However, it is unclear how the prevalence of these risk factors in adolescents is associated with socioeconomic variables within low-income populations.

Many authors state that the prevalence of cardiovascular risk factors is related to economic status[16,17] and accelerated growth in low-income populations[14]. Nevertheless, it is essential to identify and understand the risk factors associated with CVD in adolescents in order to develop specific strategies to protect this population from cardiovascular complications. Therefore, the hypothesis tested here is that the prevalence of cardiovascular risk factors is associated with socioeconomic variables may differ according to the regional income.

Methods

This is a school-based cross-sectional study, with a representative sample of adolescents, aged between 14-19 years, attending regular high school. This study was approved by the Research Ethics Committee of the Federal University of Piauí (CEP/UFPI). Additionally, a cover letter and an authorization application were submitted to the institutions visited during the study.

Data were collected in 2013 (February-June) from a low-income city located in the northeast region of Brazil, with approximately 247,505 inhabitants (Imperatriz, Maranhão); the Gini index of this region is similar to Brazil (0.56), which has the third highest inequality in the world[18]. The municipality has a population (N) of 13,335 adolescents enrolled in high school. Of these, 10,603 (79.5%) are from state public school, 424 (3.1%) from federal school and 2,318 (17.4%) from private school. The students are distributed in: 34 (57.5%) state schools, 12 (40.4%) private schools and 1 (2.1%) federal school. Where, 5,011 (37.6%) are attending the first year, 4,467 (33.5%), the second year and 3,857 (28.9%), the third year of high school[19].

The sample size (n) was based on the calculation for finite samples, with a 95% confidence level, a 2% sampling error and a 5% increased blood pressure as the outcome[20]. Ten percent (99) was added to the sample (989), in order to prevent losses and preserve the representativeness of the study. A total of 1,088 adolescents were assessed (initial sample). Stratified systematic sampling was used with the following strata: school nature (state, federal or private) and year (1st, 2nd or 3rd). To screen the students, a list was prepared with the school names in alphabetical order, from smallest to largest size, with class designation (in sequence) and alphanumeric order of the students. From the second class of the first school on, the numbers (of students) followed ascending order. Random screening followed the choice of sampling unit, the number eight, plus a constant, 12, equivalent to k=N/n (13,335/1088)[20], used as screening range of the subsequent sampling units.

Inclusion criteria for the study were adolescents enrolled in high school, who were present for data collection, not showing orthopedic conditions (preventing anthropometric assessment), not pregnant and who properly signed an informed consent form (ICF).

Two pilot studies were conducted. All measurements were performed by a single reviewer, *Ferreira* (first author), who was assisted by three note takers. Previously, the note takers were provided with assessment forms and an 8-hour training (given by the first author) divided into two days, regarding what would be assessed and how they should proceed with the test results. The first study, comprising 118 subjects, was conducted to test and select the questionnaires to be used.

The second study, comprising 35 subjects, was conducted in two steps (one week apart) to check the reliability and reproducibility of the variables measured by the questionnaires: age, gender, socioeconomic status (SES), education level of the family provider (ELFP), level of physical activity (LPA) and school type. The results were analyzed using the *Kappa (k)* coefficient, which indicated good-to-perfect agreement (*k*=0.65-1.00)[20]. Both pilot studies were designed in schools not participating in the final sample.

Outcomes

Abdominal obesity. Waist circumference (WC) was measured with inelastic tape applied to the average distance between the bottom edge of the last rib and the top of the iliac crest[21,22,23]. Measurements were taken in duplicate, and the mean values were used. The presence of abdominal obesity was assessed according to the cutoff points for gender and age[21].

Obesity and overweight. Body mass was measured (wearing light clothing and no shoes) using the *Soehnle 7755 Professional* scale (maximum capacity: 200 kg; accuracy: 0.1 kg). Height was measured with the stadiometer embedded in the scale (accuracy: 0.01 m). Body mass index (BMI) was calculated using the body weight, in kilograms (kg), divided by height in meters (m) squared (kg/m^2). Cutoff points were adjusted for gender and age[24,25]. Adolescents were classified as eutrophic (normal weight - not shown), overweight or obese.

High Blood Pressure. Blood pressure was measured using an electronic oscillometric device, *Omron* HEM-742, which was validated for adolecents[26] and provided a cuff specific for this population. Blood pressure was measured in the left arm of the subjects, who remained at rest, seated for at least 5 minutes before the measurement. After the first assessment, a two-minute interval was standardized for the second assessment. The systolic (SBP) and diastolic blood pressures (DBP) were calculated using the average of the two assessments. The cutoff points used for high blood pressure up to the age of 17 years were those recommended by the *National High Blood Pressure Education Program Working Group on Hypertension Control in Children and Adolescents*[27] and, for adolescents over 17 years, the cutoff points from *Alberti*[4] were used. Adolescents were classified into normal blood pressure (< 95th percentile and normotensive) or high blood pressure (≥ 95th percentile).

Socioeconomic variables

Socioeconomic variables. The following was investigated: socioeconomic status (SES), education level of the family provider (ELFP) and the type of school (categorized as: State, Federal and Private). The socioeconomic level and education level of the family provider were assessed according to the Brazilian Economic Classification Criterion (*Critério de Classificação Econômica do Brasil* [CCEB])[12,28].

Cutoff points used for the education level of the family provider were those from the *International Standard Classification of Education* (ISCED)[29], which were also adopted in the subsequent SES analysis. For this study, economic classes A, B, C, D and E were considered, while the education level of the family provider was categorized as: illiterate, up to 4th year of primary school, completed primary school, completed high school and completed higher education.

Confounding variables

Confounding variables. The confounding variables of this study were gender (male or female), age (14-19) and level of physical activity (LPA). LPA was assessed using the International Physical Activity Questionnaire, validated for adolescents (IPAQ-A)[30,31]; this diary identifies what type of physical activity – moderate to intense – is performed by the adolescent before applying the questionnaire. In this study, adolescents were classified as follows: meeting current PA recommendations (≥ 60 m/d) or not meeting current PA recommendations (< 60 m/d, sedentary)[32].

Statistical analysis

The outcome normality was identified by the *Shapiro-Wilk* test. The outcomes with non-normal distributions were transformed using the *Box-Cox* method. Descriptive analysis was performed with the mean (quantitative variables), standard deviation (sd), percentage (categorical variables) and 95% confidence interval (95% CI). *Pearson's* chi-square (x^2) test was performed to check the prevalence of the outcomes. Differences between the means were analyzed by Student's t-test (two means) and one-way ANOVA (more than two means) with *Tukey's post-hoc* test, both for unpaired samples.

The associations between the outcomes and independent variables were analyzed by calculating a prevalence ratio (PR), and the confidence interval (95%) was calculated using *Poisson* regression. A multilevel hierarchical analysis model with robust variance was adjusted at three levels: 1) age, 2) level of physical activity and 3) socioeconomic variables. Measurements of the effect (prevalence ratio) were tested for each outcome with all independent variables separately using unadjusted analysis (without covariates) and adjusted analysis (applying hierarchical model). The 95% significance level was adopted (p<0.05). Data were analyzed with SPSS statistical software for Windows, version 17.0. The analyses were stratified by gender because interactions between the outcomes and gender were observed, p (<0.01).

Results

The number of adolescents selected from public and private schools was 831 and 183, respectively. The loss of potential subjects, including those who refused to participate, was anticipated in the research planning and fell within the projected parameters for sample size. The study had 74 losses and/or refusals; of these, 39 adolescents were not present on the days for data collection, 4 were pregnant, and 31 did not sign the ICF, consent to complete the questionnaire or perform anthropometric assessment. Thus, the final sample (1,014 adolescents) consisted of 796 students (78.5%) from the state, 183 (18.0%) from the private and 35 (3.5%) from the federal schools, which preserved the representativeness of the population, extracted from 14 state, 6 private and 1 federal schools.

Table 1 shows the prevalence of the socioeconomic variables, confounding variables and outcomes by gender. In this study, 54.8% of the adolescents were girls and the mean age was 16.2 years. With regard to the socioeconomic variables, the percentage of students in each SES category and school type varied significantly, with more of the study adolescents in class B and in state school. For LPA, most of the students self-reported to be active, especially the female subjects.

All of the cardiovascular risk factors assessed had high prevalence. With regard to gender, the most prevalent outcomes in females were obesity, overweight and abdominal obesity, whereas, high blood pressure was more prevalent in males.

Table 2 shows the PR for the socioeconomic variables tested for the outcomes overweight and obesity. The unadjusted analysis did not show a statistical association with any of the variables. In the adjusted model, SES was associated with overweight in the female

Table I
Socioeconomic, anthropometric characteristics and cardiovascular risk factors according to gender

Variable	*Total*	*Male*	*Female*	*p-value**
N	1014	458 (45.2%)	556 (54.8%)	
Age, mean ±sd	16.2±1.29	16.3±1.29	16.1±1.28	0.004**
SES, n(%)				
A	87 (8.6)	45 (4.4)	42 (4.1)	
B	478 (47.1)	238 (23.5)	240 (23.7)	0.003
C	391 (38.6)	156 (15.4)	235 (23.2)	
D and E	58 (5.7)	19 (1.9)	39 (3.8)	
ELFP, n(%)				
Illiterate	71 (7.0)	23 (2.3)	48 (4.7)	
≤ 4th year Primary	153 (15.1)	62 (6.1)	91 (9.0)	
Completed Primary	187 (18.4)	83 (8.2)	104 (10.3)	0.078
Completed High School	368 (36.3)	180 (17.8)	188 (18.5)	
Completed Higher Education	235 (23.2)	110 (10.8)	125 (12.3)	
School nature, n(%)				
State	796 (78.5)	344 (33.9)	452 (44.6)	
Federal	35 (3.5)	20 (2.0)	15 (1.5)	0.048
Private	183 (18.0)	94 (9.3)	89 (8.8)	
LPA, n(%)				
>= 60 m/d	675 (66.6)	321 (31.7)	354 (34.9)	0.018
< 60 m/d	339 (33.4)	137 (13.5)	202 (19.9)	
Cardiovascular risk factors, n(%)				
BMI – Obesity	38 (3.8)	18 (3.9)	20 (3.6)	0.179
BMI – Overweight	133 (13.1)	60 (13.1)	73 (13.1)	0.179
Abdominal obesity	230 (22.7)	84 (18.3)	146 (26.3)	0.003
High BP	216 (21.3)	121 (26.4)	95 (17.1)	<0.001
Anthropometric data and blood pressure, mean ±sd				
BMI (kg/m2)	21.1±3.71	21.1±3.5	21.2±3.8	0.881**
WC (cm)	75.4±9.5	77.0±8.9	74.1±9.7	<0.001**
SBP (mmHg)	119.1±12.9	124.1±12.9	114.9±11.5	<0.001**
DBP (mmHg)	68.8±8.7	68.2±8.9	69.3±8.4	0.029**

**P*-value for Pearson's chi-square test; ***P*-value for Student's t-test; SES: socioeconomic status; ELFP: education level of the family provider; LPA: level of physical activity; BMI: body mass index; WC: waist circumference; SBP: systolic blood pressure; DBP: diastolic blood pressure.

Table II
Prevalence ratio (PR) for overweight and obesity according to socioeconomic status, by gender

Overweight by BMI				
Independent variables	**Male**		**Female**	
	PR⁰ (95% CI)	**PR¹ (95% CI)**	**PR⁰ (95% CI)**	**PR¹ (95% CI)**
SES				
A	1.26 (0.14-11.42)	4.77 (0.35-64.56)	1.50 (0.51-5.12)	1.71 (1.13-2.87)
B	0.96 (0.13-6.98)	2.27 (0.23-21.80)	1.51 (0.50-3.57)	1.82 (0.45-3.21)
C	0.24 (0.02-2.56)	0.40 (0.03-5.11)	1.02 (0.45-3.23)	1.15 (0.83-2.01)
D and E	1	1	1	1
ELFP				
Illiterate	1	1	1	1
≤ 4th Primary	0.37 (0.05-2.48)	0.29 (0.04-1.99)	1.58 (0.17-14.80)	1.44 (0.14-14.37)
Completed Primary	0.28 (0.04-1.86)	0.16 (0.02-1.18)	0.92 (0.09-9.93)	0.86 (0.06-11.87)
Completed High School	0.51 (0.11-2.26)	0.24 (0.05-1.12)	2.30 (0.30-17.70)	1.89 (0.18-19.85)
Completed Higher Education	0.42 (0.08-2.15)	0.12 (0.02-0.83)	1.92 (0.23-16.01)	1.28 (0.09-17.68)
School nature				
State	1	1	1	1
Federal	1.09 (0.44-2.12)	1.50 (0.47-3.31)	1.04 (0.57-1.91)	1.11 (0.37-1.73)
Private	1.41 (0.51-3.85)	0.80 (0.28-2.26)	1.69 (0.63-4.54)	1.50 (0.52-4.27)
Obesity by BMI				
Independent variables	**Male**		**Female**	
	PR⁰ (95% CI)	**PR¹ (95% CI)**	**PR⁰ (95% CI)**	**PR¹ (95% CI)**
SES				
A	5.49 (0.77-39.04)	5.41 (0.75-38.88)	1.62 (0.51-5.12)	1.62 (0.51-5.16)
B	2.31 (0.33-16.08)	2.27 (0.32-15.90)	1.34 (0.50-3.57)	1.33 (0.50-3.51)
C	2.07 (0.29-14.70)	2.00 (0.28-14.09)	1.20 (0.45-3.23)	1.20 (0.44-3.22)
D and E	1	1	1	1
ELFP				
Illiterate	1	1	1	1
≤ 4th Primary	0.74 (0.15-3.78)	0.75 (0.15-3.79)	2.11 (0.62-7.12)	2.11 (0.63-7.11)
Completed Primary	1.52 (0.36-6.39)	1.51 (0.36-6.36)	2.46 (0.75-8.05)	2.43 (0.75-7.94)
Completed High School	1.79 (0.46-7.02)	1.87 (0.48-7.25)	2.21 (0.70-7.00)	2.19 (0.69-6.94)
Completed Higher Education	1.57 (0.38-6.39)	1.62 (0.39-6.64)	2.05 (0.62-6.71)	2.03 (0.62-6.69)
School nature				
State	1	1	1	1
Federal	1.29 (0.44-3.81)	1.45 (0.49-4.32)	1.03 (0.57-1.88)	1.01 (0.53-1.89)
Private	1.55 (0.92-2.61)	**1.79 (1.04-3.08)**	1.10 (0.63-1.92)	1.09 (0.60-1.95)

SES: socioeconomic status; ELFP: education level of the Family provider; PR: prevalence ratio; CI: confidence interval; ⁰: unadjusted analysis; ¹: analysis adjusted for variable age and level of physical activity; Significant associations were highlighted in **bold** (p<0.05).

adolescents (1.71 [95% CI: 1.13-2.87]) from class A compared to the girls from class D and E; whereas the boys from private schools had a higher likelihood of obesity (1.79 [95% CI: 1.04-3.08]) compared to the boys in public or state schools.

Table 3 provides the PR for abdominal obesity by socioeconomic status. For this outcome, in both the unadjusted (PR: 1.66; 95% CI: 1.10-2.52) and adjusted (PR: 1.64; 95% CI: 1.06-2.54) analyses, the male adolescents from private schools were more likely to have abdominal obesity than were the boys from public or state schools. No association between high blood pressure and the socioeconomic variables (table 4) was found.

Discussion

There was a high prevalence of cardiovascular risk factors in the adolescents from this low-income region of Brazil, irrespective of gender. In low-income regions (included Brazil), the prevalence continues to

Table III
Prevalence ratio (PR) for overweight and obesity according to socioeconomic status, by gender

	Male		Female	
	PR^0 (95% CI)	PR^1 (95% CI)	PR^0 (95% CI)	PR^1 (95% CI)
SES				
A	2.25 (0.74-6.84)	2.27 (0.76-6.78)	1.39 (0.71-2.72)	1.42 (0.73-2.78)
B	1.17 (0.40-3.42)	1.18 (0.41-3.39)	0.97 (0.55-1.74)	0.99 (0.55-1.76)
C	0.85 (0.28-2.59)	0.86 (0.29-2.59)	1.01 (0.57-1.80)	1.01 (0.57-1.80)
D and E	1	1	1	1
ELFP				
Illiterate	1	1	1	1
≤ 4th Primary	0.99 (0.29-3.41)	0.97 (0.28-3.37)	1.27 (0.66-2.42)	1.27 (0.66-2.42)
Completed Primary	1.39 (0.44-4.38)	1.36 (0.43-4.33)	1.06 (0.55-2.05)	1.08 (0.56-2.08)
Completed High School	1.62 (0.54-4.82)	1.59 (0.53-4.73)	1.45 (0.80-2.63)	1.47 (0.81-2.66)
Completed Higher Education	1.39 (0.45-4.30)	1.36 (0.43-4.25)	1.23 (0.66-2.30)	1.24 (0.66-2.32)
School nature				
State	1	1	1	1
Federal	1.25 (0.50-3.11)	1.24 (0.50-3.08)	0.52 (0.14-1.92)	0.53 (0.14-1.93)
Private	1.66 (1.10-2.52)	1.64 (1.06-2.54)	1.28 (0.91-1.80)	1.30 (0.92-1.85)

SES: socioeconomic status; ELFP: education level of the Family provider; PR: prevalence ratio; CI: confidence interval; ^{0}: unadjusted analysis; ^{1}: analysis adjusted for variable age and level of physical activity; Significant associations were highlighted in **bold** ($p<0.05$).

Table IV
Prevalence ratio (PR) for high blood pressure according to socioeconomic status, by gender

	Male		Female	
	PR^0 (95% CI)	PR^1 (95% CI)	PR^0 (95% CI)	PR^1 (95% CI)
SES				
A	2.25 (0.74-6.84)	2.27 (0.76-6.78)	1.39 (0.71-2.72)	1.42 (0.73-2.78)
B	1.17 (0.40-3.42)	1.18 (0.41-3.39)	0.97 (0.55-1.74)	0.99 (0.55-1.76)
C	0.85 (0.28-2.59)	0.86 (0.29-2.59)	1.01 (0.57-1.80)	1.01 (0.57-1.80)
D and E	1	1	1	1
ELFP				
Illiterate	1	1	1	1
≤ 4th Primary	0.99 (0.29-3.41)	0.97 (0.28-3.37)	1.27 (0.66-2.42)	1.27 (0.66-2.42)
Completed Primary	1.39 (0.44-4.38)	1.36 (0.43-4.33)	1.06 (0.55-2.05)	1.08 (0.56-2.08)
Completed High School	1.62 (0.54-4.82)	1.59 (0.53-4.73)	1.45 (0.80-2.63)	1.47 (0.81-2.66)
Completed Higher Education	1.39 (0.45-4.30)	1.36 (0.43-4.25)	1.23 (0.66-2.30)	1.24 (0.66-2.32)
School nature				
State	1	1	1	1
Federal	1.25 (0.50-3.11)	1.24 (0.50-3.08)	0.52 (0.14-1.92)	0.53 (0.14-1.93)
Private	1.66 (1.10-2.52)	1.64 (1.06-2.54)	1.28 (0.91-1.80)	1.30 (0.92-1.85)

SES: socioeconomic status; ELFP: education level of the Family provider; PR: prevalence ratio; CI: confidence interval; ^{0}: unadjusted analysis; ^{1}: analysis adjusted for variable age and level of physical activity.

increase, whereas in high-income regions, the prevalence has stabilized over the past two decades[11]. An increasing prevalence of overweight has been observed in mid- and low-income regions, making it an even greater public health challenge to the government because obesity has a high cost of treatment[11,26,33].

Obesity and overweight in adolescence are good predictors for cardiovascular risk factors, mainly because the habits adopted at that age tend to persist into adulthood[10,23]. In our sample, boys and girls had a similar prevalence of obesity and overweight, which corroborates with the data available in the literature[2,3,10,23,24]. People who are obese during childhood and adolescence are more likely to be obese during adulthood, and obese adults are at an increased risk for stroke and many chronic diseases, including coronary heart disease, hypertension, type 2 diabetes, and certain types of cancer[2,3,4,8,9]. Furthermore, in this study the girls had a higher prevalence of abdominal obesity than boys. This greater prevalence of AO may be partly explained because females have a higher percentage of body fat than males, regardless of pubertal stage[21]; while there is lack of consensus[2,34], the study results are generally supported by the international findings[16]. AO may be associated with different eating habits in females and males, and these relationships may be mediated by familial contexts[22].

We found a higher prevalence of high blood pressure among adolescents, especially in boys, this finding is supported by other studies in Latin America[23]. A recent study showed that the HBP in the low-income population is initiated in childhood and has a strong tendency to be perpetuated until adulthood[11]; moreover, the same study suggested that higher fractional shortening might be the first cardiac adaption of children leading to high blood pressure[11].

The coexistence or association of obesity, overweight, abdominal obesity and HBP are good predictors of the risk of developing hypertension in adolescents[8]. In general, the literature explains the high prevalence of cardiovascular risk factors in adolescents, primarily by the changes in environmental factors in the last decades, such as the patterns of dietary intake (increased consumption of simple sugars, processed foods, and insufficient intake of fruits and vegetables)[6,22] and the patterns of physical activity (reduced physical activity and increased sedentary behavior)[6,7,12].

The prevalence of obesity, overweight and abdominal obesity were associated with socioeconomic factors in this study. The girls with high SES showed an increased likelihood for overweight, whereas, boys from private schools showed an increased likelihood to have obesity and abdominal obesity. In this region, the nature of the school has a strong economic bias because of the paid format; naturally, students of lower economic status are less likely to attend private schools.

This study indicates that, somehow, cardiovascular risk factors were associated with better economic status in adolescents from a low-income area[17]. In contrast, many studies in the literature state that in developing countries, such as Brazil, subjects with low SES show a higher prevalence of such factors[16]. Indeed, a recent international study showed a reduced prevalence of obesity in adolescents with high SES, whereas, in subjects with reduced SES, obesity is increased[13].

The contribution of the socioeconomic status may be associated with the different patterns of physical activity and caloric intake found between the SES levels[11,13,16]. The literature indicates that adolescents with a higher SES and more educated parents are more active and eat less calories, whereas children with lower incomes tend to eat more calories and to not have lifestyles that are active enough to offset their energy intake[13]. In this regard, a recent study in low-income populations showed an increased prevalence of sedentary behavior in adolescents that was associated with increased obesity and overweight[17].

Strategies to change lifestyle[35] and encourage physical activity are required to reduce the prevalence of cardiovascular risk factors in low-income adolescents; however, in order to achieve a more effective intervention, the socioeconomic dynamics of the population must be understood. A limiting factor of this study was its cross-sectional nature, which is unable to establish causal relationships. Another limitation of this study was the measuring tools for socioeconomic variables and the level of physical activity, which were self-reported and submitted to pre-defined scales. However, the logistics to use more accurate methods, such as direct observation, would be costly and difficult due to the epidemiological scope of this study. Studies in other low-income populations from different geographical areas or from a longitudinal perspective could be conducted to confirm these findings.

Conclusion

A high prevalence of cardiovascular risk factors was found in the adolescents in the low-income region studied. Boys from private schools were more likely to have obesity and abdominal obesity, and girls with high SES were more likely to be overweight. High blood pressure did not seem to be directly associated with socioeconomic factors in this population. The results suggest that healthy habits should be promoted in the school environment, in order to reduce the prevalence of cardiovascular risk factors in adolescence, taking into account their socioeconomic status.

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