



Original/Otros

## Cardiovascular risk and associated factors in adolescents

Pedro Paulo do Prado Junior<sup>1</sup>, Franciane Rocha de Faria<sup>2</sup>, Eliane Rodrigues de Faria<sup>3</sup>, Sylvia do Carmo Castro Franceschini<sup>4</sup> and Silvia Eloiza Priore<sup>4</sup>

<sup>1</sup>Lecturer the Department of Medicine and Nursing at the Federal University of Viçosa, Minas Gerais. <sup>2</sup>Lecturer the Department of Nutrition at the Federal University of Viçosa, Minas Gerais. <sup>3</sup>Lecturer at the Federal University of Espírito Santo, Vitória, Espírito Santo. <sup>4</sup>Lecturer in the graduate program in Nutrition Science at the Federal University of Viçosa, Minas Gerais (Brazil).

### Abstract

**Background:** changes in lifestyle are related to early exposure of adolescents to comorbidities associated with cardiovascular disease. These conditions may have consequences in adulthood.

**Objective:** to determine the prevalence of cardiovascular risk and its associated factors in the three phases of adolescence.

**Methods:** a cross-sectional study involving adolescents 10-19 years old in the city of Viçosa distributed in three stages. We evaluated laboratory tests, body mass index classified into Z-score according to gender and age, and the percentage of body fat classified by gender. We used the chi-square test, chi-square partition with Bonferroni correction and Poisson regression. The significance level was  $\alpha < 0.05$ . The project was approved by the UFV Committee of Ethics and Research with Humans.

**Results:** overweight, excess body fat, lipid profile, sedentary behavior, and history of CVD in family were the most prevalent cardiovascular risk factors among adolescents. The adolescents had higher rates of overweight and excess fat. As for the stages, the first one showed a higher percentage of individuals with sedentary behavior, overweight, total cholesterol and LDL in comparison with other stages. Individuals with changes in nutritional status were more likely to develop hypertension, changes in total cholesterol, LDL, triglycerides, insulin, HOMA and low HDL when compared to healthy individuals.

**Conclusions:** the cardiovascular risk factors have been observed in younger and younger individuals and are important factors to identify a population at risk.

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Key words: Adolescent. Risk factors. Cardiovascular disease.

### RIESGO CARDIOVASCULAR Y FACTORES ASOCIADOS EN ADOLESCENTES

#### Resumen

**Introducción:** los cambios en el estilo de vida están relacionados con la exposición temprana de los adolescentes a las comorbilidades asociadas a la enfermedad cardiovascular. Estas condiciones pueden tener consecuencias en la edad adulta.

**Objetivo:** determinar la prevalencia de riesgo cardiovascular y factores asociados en las tres fases de la adolescencia.

**Métodos:** estudio transversal que incluye a adolescentes de 10-19 años en la ciudad de Viçosa, distribuidos en tres fases. Se evaluaron las pruebas de laboratorio, el índice de masa corporal clasificadas en Z-score, según el sexo y la edad, y el porcentaje de grasa corporal, clasificados por sexo. Se utilizó la prueba de chi-cuadrado, la partición de chi-cuadrado con corrección de Bonferroni y la regresión de Poisson. El nivel de significación fue  $\alpha < 0,05$ . El proyecto fue aprobado por el Comité de Ética en Investigación de la UFV en humanos.

**Resultados:** el sobrepeso, la grasa corporal, el perfil lipídico, el comportamiento sedentario y la historia de enfermedades cardiovasculares en la familia fueron los factores de riesgo cardiovascular más prevalentes entre los adolescentes. Los adolescentes tenían tasas más altas de sobrepeso y grasa. En cuanto a las etapas, la inicial mostró un mayor porcentaje de individuos con comportamiento sedentario, sobrepeso y colesterol total y LDL en comparación con otras fases. Los individuos con cambios en el estado nutricional eran más propensos a desarrollar hipertensión, cambios en el colesterol total, LDL, triglicéridos, insulina, HOMA y HDL bajo, en comparación con los individuos sanos.

**Conclusiones:** los factores de riesgo cardiovascular se han observado en personas cada vez más jóvenes y son factores importantes para identificar una población en riesgo.

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Palabras clave: Adolescente. Factores de riesgo. Enfermedad cardiovascular.

**Correspondence:** Pedro Paulo do Prado Junior.  
Lecturer the Department of Medicine and Nursing at the  
Federal University of Viçosa, Minas Gerais, Brazil, /  
CCBII - Campus Universitário CEP: 36570-900. Viçosa – MG.  
E-mail: pedro.prado@ufv.br

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## Introduction

Brazil is going through an epidemiological transition, where we observe a decrease in mortality by infectious diseases and an increase in chronic diseases.<sup>1</sup> Cardiovascular diseases (CVD) are the leading causes of death in Brazil<sup>2</sup>.

Vascular lesions that accompany these disorders are associated with atherosclerosis<sup>3</sup> often initiated in childhood or adolescence<sup>4</sup> with permanence and consequence in adulthood<sup>5</sup>.

Changes in lifestyle and physical activity level promote early exposure of children and adolescents to obesity and its associated comorbidities such as cardiovascular and metabolic diseases<sup>6</sup>. Knowing the CVD risk factors is relevant to the development of strategies for prevention and treatment. Among them is excess weight, which can be found in children and adolescents<sup>7</sup>.

Excess weight is associated with dyslipidemia<sup>8</sup>. Hypercholesterolemia, particularly increased LDL and decreased HDL levels are the major predictors of CVD<sup>9</sup>.

Sedentary lifestyle, another risk for CVD, is present in childhood and adolescence, justified by changing habits. Unhealthy lifestyle with decreased physical activity and increased sedentary lifestyle is strongly related to the development and maintenance of obesity<sup>10-11</sup>.

Obesity, considered a growing problem, which affects 21.5% of the Brazilian adolescent population<sup>12</sup>, is related to conditions such as hypertension, diabetes mellitus, lipid profile changes, orthopedic problems, psychosocial dysfunction, among others<sup>13</sup>.

Based on the above, the objective of this study is to determine the prevalence of cardiovascular risk factors and risk factors in the three phases of adolescence.

## Methods

A cross-sectional study was performed with 676 adolescents aged 10 to 19 years from Viçosa-MG.

For the sample we used the software EPIINFO 6.04 from specific formula for cross-sectional studies. The population of 11,898 regarding the number of adolescents between the ages of the study in the city was considered, according to census (2010), with a prevalence of 50% when considering multiple cardiovascular risk factors as an outcome<sup>14</sup>, acceptable variability of 5% and confidence level of 99%, totaling a minimum sample of 628 adolescents. Those with chronic diseases, pregnant or who were using lipid lowering drugs were not included.

The clinical and lifestyle data and family history were obtained through interviews. The examinations were performed after fasting for 12 hours in the clinical laboratory of the UFV Health Division, assessing fasting plasma glucose, triglycerides, total cholesterol and its fractions, fasting insulin, HOMA-IR and blood

count. The classification of the lipid profile, was considered elevated total cholesterol >150 mg/dL, LDL cholesterol and triglycerides high >100 mg/dL and HDL cholesterol <45 mg/dL, in relation to insulin and HOMA were considered high values >15 mU/L and >3.16, respectively, according to the I Atherosclerosis Prevention Guidelines in Childhood<sup>15</sup>.

Blood pressure was measured based on the protocol established by the VI Brazilian Guidelines on Hypertension<sup>16</sup>.

Sedentary behavior was assessed as self-reported downtime during every week in front of the television, video games and computer, characterized as screen time (ST) and classified as sedentary behavior ST > 2 hours/day<sup>17</sup>.

We evaluated the weight through an electronic digital scale with a maximum capacity of 150 kg and sensitivity of 50 g; for the height we used a portable stadiometer with a length of 2.13 m and a 0.1 cm resolution. The Body Mass Index (BMI) was classified as Z-score according to gender and age<sup>18</sup>. The body fat percentage (BF%) was obtained by the equipment of vertical electrical bioimpedance with eight tactile electrodes (InBory 230<sup>®</sup>) and classified according to gender<sup>19</sup>.

BMI  $\geq$  Z-Scores + 1 as well as body fat percentage above 25% (female) and 20% (male) were grouped and classified as overweight (overweight/obesity) and excess body fat, respectively.

After an evaluation of BMI and BF%, the following groups were created: G1 - eutrophic (BMI and BF% within normal limits); G2 - Excess body fat (normal BMI and high BF%) and G3 - Excess weight and body fat (BMI and BF% above the normal range).

The adolescents were distributed into the three stages of adolescence, described as follows: 10 to 13 years – initial; 14 to 16 years – intermediate, and 17 to 19 years – final.<sup>20</sup>

Analysis of the data was performed by the Statistical Package for Social Sciences (SPSS - Chicago, IL, United States) version 20.0 for which the relative and absolute frequencies of the risk factors were calculated for gender, adolescence stage and nutritional status. The difference between the proportions was assessed using the chi-square and the Fisher's exact tests when needed. For the outcome, variables with more than two categories used chi-square partition with Bonferroni correction. The prevalence ratio (PR) and their confidence intervals (95% CI) were calculated using Poisson regression for all variables with  $p < 0.05$  in the chi-square test performed by the Data Analysis and Statistical Software (STATA - Stata Corp., College Station, TX, USA). To evaluate the association between nutritional status and cardiovascular risk factors the PR was adjusted for gender and adolescence stage, being determined by Poisson regression. The significance level considered was  $\alpha < 0.05$ .

Participants were informed about the study goals and about signing the informed consent form. For un-

deranged teenagers the document was signed by their guardians. All teenagers had a follow-up appointment and were informed about the changes observed. The study was approved by the UFV Ethics and Research with Humans Committee (Case No. 163/2012).

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## Results

The study included 676 adolescents aged 10 to 19 years, with 378 (55.9%) female. In the division by the adolescence stages we observed: 280 (41.4%) in the initial, 204 (30.2%) in the intermediate and 192 (28.4) in the final stage.

As for the nutritional status, Group 01 consisted of 337 (49.9%), Group 02 of 178 (26.3%) and Group 03 of 161 (23.8%).

In the overall evaluation of the sample, 161 (23.8%) of the adolescents were overweight and 339 (50.1%) with excess of body fat.

Among the adolescents, 60.5% had total cholesterol above the recommendation (>150mg/dl), 34.3% high levels of LDL (>100mg/dl) and 15.9% high levels of triglycerides (>100mg/dl) and 35.4% low HDL levels (<45mg/dl). Sedentary behavior was observed in 64.8% and family history of CVD was reported by 44.2% of the adolescents.

As to gender (Table I), females had a higher percentage of body fat excess and high total cholesterol and

insulin. Males a higher percentage of low HDL and blood pressure (BP) above the P90 were noted.

Adolescents in the initial stage showed a higher percentage of sedentary behavior, overweight, high total cholesterol and LDL in comparison with the other stages (Table II).

Group 03 adolescents were more likely to develop hypertension and changes in LDL, hypertriglyceridemia, insulin, high HOMA and low HDL. Group 02 had a higher percentage of adolescents with high total cholesterol, hypertriglyceridemia, insulin, altered HOMA and low HDL compared to Group 01. The percentage of individuals with sedentary behavior was higher in Group 01 when compared to the others (02 and 03). Groups 02 and 03 behaved in similar ways with regard to cardiovascular risk factors except for the variables: HDL (low), triglycerides, insulin, altered HOMA and BP > P90, where Group 03 had higher percentages (Table III).

Through the bivariate analysis (Table IV) excess of fat, altered insulin, total cholesterol and high triglycerides for females and low HDL and blood pressure > P90 for males were confirmed.

Overweight, sedentary behavior, high total cholesterol and LDL were maintained in individuals in the initial stage compared to the other stages.

Group 03 maintained higher numbers of adolescents with low HDL, insulin and altered HOMA, high LDL and triglycerides compared to Group 01. Group 02 maintained a higher number of adolescents with low insulin and HOMA and high triglycerides compared to Group 01.

**Table I**  
Prevalence of anthropometric and clinical changes, and family history in relation to the adolescents' gender

Risk factors	Total n (%)	Gender		p*
		Male n=298	Female n=378	
Overweight	161 (23.8)	77 (25.8)	84 (22.2)	0.27
BF excess	339 (50.1)	110 (36.9)	229 (60.6)	<b>&lt; 0.001</b>
BP > P90	21 (3.1)	14 (4.7)	7 (1.9)	<b>0.03</b>
Family History of CVD	299 (44.2)	125 (41.9)	174 (46)	0.17
Sedentary lifestyle	438 (64.8)	182 (41.6)	256 (58.4)	0.07
TC ≥ 150 mg/dL	409 (60.5)	158 (53)	251 (66.4)	<b>&lt; 0.001</b>
LDL ≥ 100 mg/dL	232 (34.3)	92 (30.9)	140 (37)	0.09
TG ≥ 100 mg/dL	107 (15.8)	38 (12.8)	69 (18.3)	0.05
HDL ≤ 45 mg/dL	239 (35.4)	128 (43)	111 (29.4)	<b>&lt; 0.001</b>
Glucose ≥ 100 mg/dL	6 (0.9)	3 (1.0)	3 (0.8)	0.76
Insulin ≥ 15 mU/mL	77 (11.7)	25 (8.4)	52 (13.8)	<b>0.02</b>
HOMA ≥ 3.16	79 (11.7)	27 (9.1)	52 (13.8)	0.05

\* Chi-square: p < 0.05; BF: Body Fat; BP: Blood Pressure; TC: Total Cholesterol; TG: Triglycerides; CVD: Cardiovascular Disease; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein.

**Table 2**  
Prevalence of anthropometric and clinical changes, and family history in relation to the adolescence stage

Risk Factors	Total n (%)	Adolescence stages			p*
		Initial n = 280	Intermediate n = 178	Final n = 161	
Overweight	161 (23.8)	82 (29.3)	42 (20.6)	37 (19.3)	<b>0.01</b> ‡ §
BF excess	339 (50.1)	132 (47.1)	112 (54.9)	95 (49.5)	0.23
BP > P90	21 (3.1)	9 (3.2)	8 (3.9)	4 (2.1)	0.56 †
Family History of CVD	299 (44.2)	114 (40.7)	105 (51.5)	80 (41.7)	0.34
Sedentary lifestyle	438 (64.8)	154 (35.2)	150 (34.2)	134 (30.6)	<b>&lt; 0.001</b> ‡ §
TC ≥ 150 mg/dL	409 (60.5)	193 (68.9)	110 (53.9)	106 (55.2)	<b>0.001</b> ‡ §
LDL ≥ 100 mg/dL	232 (34.3)	125 (44.6)	49 (24)	58 (30.2)	<b>&lt; 0.001</b> ‡ §
TG ≥ 100 mg/dL	107 (15.8)	50 (17.9)	31 (15.2)	26 (13.5)	0.43
HDL ≤ 45 mg/dL	239 (35.4)	95 (33.9)	73 (35.8)	71 (37)	0.78
Glucose ≥ 100 mg/dL	6 (0.9)	4 (1.4)	1 (0.5)	1 (0.5)	0.45
Insulin ≥ 15 mU/mL	77 (11.7)	37 (13.2)	23 (11.3)	17 (8.9)	0.34
HOMA ≥ 3.16	79 (11.7)	38 (13.6)	25 (12.3)	16 (8.3)	0.21

BF: Body Fat; BP: Blood Pressure; TC: Total Cholesterol; TG: Triglycerides; CVD: Cardiovascular Disease; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein

\* : Partition of chi-square with Bonferroni correction, p < 0.016; †: Fisher's exact test; ‡: Comparison between the initial and the intermediate stages; §: Comparison between the initial and the final stages.

**Table III**  
Prevalence of anthropometric and clinical changes, and family history in relation to the nutritional status of adolescents

Risk factors	Total n (%)	Nutritional Status			p**
		Group 01 n= 337	Group 02 n= 178	Group 03 n= 161	
Overweight	161 (23.8)	-	-	161 (100)	-
BF excess	339 (50.1)	-	178 (100)	161 (100)	-
BP > P90	21 (3.1)	9 (2.7)	1 (0.6)	11 (6.8)	<b>0.004</b> †, ‡, §
Family History of CVD	299 (44.2)	151 (44.8)	85 (47.8)	63 (39.1)	0.31
Sedentary lifestyle	438(64.8)	202 (46.1)	129 (29.5)	107 (24.4)	<b>0.01</b> ¶, #
TC ≥ 150 mg/dL	409 (60.5)	189 (56.1)	121 (68)	99 (61.5)	<b>0.03</b> //
LDL ≥ 100 mg/dL	232 (34.3)	100 (29.7)	63 (35.4)	69 (42.9)	<b>0.01</b> ‡, §
TG ≥ 100 mg/dL	107 (15.8)	32 (9.5)	29 (16.3)	46 (28.6)	<b>&lt; 0.001</b> ‡, §, //
HDL ≤ 45 mg/dL	239 (35.4)	110 (32.6)	47 (26.4)	82 (50.9)	<b>&lt; 0.001</b> ‡, §, //
Glucose ≥ 100 mg/dL	6 (0.9)	2 (0.6)	1 (0.6)	3 (1.9)	0.31
Insulin ≥ 15 mU/mL	77 (11.7)	11 (3.3)	17 (9.6)	49 (30.4)	<b>&lt; 0.001</b> ‡, §, //
HOMA ≥ 3.16	79 (11.7)	15 (4.5)	17 (9.6)	47 (29.2)	<b>&lt; 0.001</b> ‡, §, //

Group 01 - BMI(Eutrophic) BF%(Normal); Group 02 - BMI(Eutrophic) BF% (Altered); Group 03 – BMI (Altered) BF% (Altered);

BF – Body Fat; BP – Blood Pressure; TC – Total Cholesterol; TG - Triglycerides; CVD - Cardiovascular Disease;

LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein

\* : Partition of chi-square with Bonferroni correction, p < 0.016; †: Fisher's exact test;

‡ - Comparison Group 03 and Group 01; § - Comparison Group 03 and Group 02; // - Comparison Group 02 and Group 01;

¶ - Comparison Group 01 and Group 03; # - Comparison Group 01 and Group 02.

**Table IV**

*Bivariate analysis between risk factors for cardiovascular diseases and the variables gender, adolescence stage and nutritional status*

	Overweight		Body Fat Excess		Sedentary Lifestyle		Insulin		HOMA		High Cholesterol		Low HDL		High LDL		High Triglycerides		Blood Pressure		
	PR	CI (95%)	PR	CI (95%)	PR	CI (95%)	PR	CI (95%)	PR	CI (95%)	PR	CI (95%)	PR	CI (95%)	PR	CI (95%)	PR	CI (95%)	PR	CI (95%)	
Gender	M	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	F	0.97	0.92-1.02	1.17	1.11-1.23	1.04	0.99-1.08	1.04	1.0-1.09	1.02	0.99-1.04	1.08	1.03-1.13	0.90	0.85-0.95	1.04	0.99-1.10	1.04	1.0-1.09	1.01	1.00-1.02
Adolescence Stage	I	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	II	0.93	0.87-0.99	1.05	0.99-1.11	1.11	1.06-1.17	0.98	0.93-1.03	0.99	0.96-1.02	0.91	0.86-0.96	1.01	0.95-1.08	0.85	0.80-0.91	0.97	0.92-1.03	0.99	0.97-1.01
	III	0.92	0.86-0.98	1.01	0.95-1.08	1.09	1.03-1.15	0.96	0.91-1.01	0.97	0.94-1.00	0.91	0.86-0.97	1.02	0.95-1.09	0.90	0.84-0.95	0.96	0.90-1.02	1.00	0.99-1.02
Nutritional Status	G1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	G2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	G3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

PR - Poisson Regression; M - Male; F - Female; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; I - Initial Stage; II - Intermediate Stage; III - Final Stage; G1 - BMI(Eutrophic) BF%(Normal); G2 - BMI(Eutrophic) BF%(Altered); G3 - BMI(Altered) BF%(Altered).

The regression analysis adjusted for gender and adolescence stage (Table V) showed that overweight individuals showed changes in the number of LDL and high triglycerides, low HDL and changes in blood pressure values. Adolescents with excess body fat had higher LDL and triglyceride levels and low HDL. Sedentary behavior and family history of CVD were not associated with risk factors for cardiovascular disease.

**Discussion**

Overweight, excess body fat, lipid profile, sedentary behavior and family history of CVD were the cardiovascular risk factors more prevalent in the participants of the study.

The prevalence of overweight (23.8%) among the adolescents studied was higher than the data of the POF 2008-2009<sup>7</sup> which found a prevalence of 20.5%, and higher than the 17.3% and 18.5% respectively found in studies in the Brazilian Northeast and Southeast<sup>21-22</sup>. The relevance of these data is the fact that young adults are exposed to obesity in the occurrence of weight gain in the transitional stages of life. Study in the Brazilian population showed that the incidence of overweight among individuals with low or normal weight at age 20 is estimated at 40% in males and 30% for females. The persistence of obesity is estimated at 65% in males and 47% in females<sup>23</sup>. The incidence and persistence of obesity among adults is associated with the development of chronic diseases and increased risk of early mortality<sup>24</sup>.

Excess body fat (50.1%) reaffirms the importance of the evaluation of this variable in the identification of risk factors for cardiovascular disease. Various instruments have been used to determine obesity. It can be observed in the literature that many authors use BMI as a way to determine excess body fat, but in a systematic review and a meta-analysis<sup>25</sup>, it can be noted that BMI has high specificity but low sensitivity to detect excess adiposity and cannot identify more than a quarter of children with excess body fat percentage. Obesity is a pathologic condition that adds risk factors for cardiovascular diseases such as insulin resistance, diabetes, hypertension and dyslipidemia<sup>26</sup>.

Excess weight and body fat in adolescents in this study was associated with changes in the lipid profile, especially LDL and high triglycerides and low HDL.

When stratifying by adolescence stage, the initial stage had higher overweight, sedentary behavior, changes in lipid profile for total cholesterol > 150 mg/dL and LDL > 100 mg/dL when compared to the other stages. These findings reinforce the importance of the work of disease prevention and health promotion, changes in lifestyle especially with regard to changes in dietary patterns and physical activity level<sup>27-28</sup>.

When assessing the nutritional situation Group 03 showed a higher grouped cardiovascular risk factor. Group 02 had changes in the lipid profile (TC > 150

**Table V**  
Adjusted analysis between risk factors for cardiovascular disease and gender and adolescence stage

		High Cholesterol		High LDL		Low HDL		High Triglycerides		Blood Pressure > P90	
		PR*	CI (95%)	PR*	CI (95%)	PR*	CI (95%)	PR*	CI (95%)	PR*	CI (95%)
Overweight	No	1		1		1		1		1	
	Yes	1.00	0.95-1.05	1.07	1.01-1.14	1.15	1.09-1.22	1.14	1.08-1.22	0.97	0.95-0.99
Body Fat Excess	No	1		1		1		1		1	
	Yes	1.03	0.99-1.08	1.06	1.00-1.12	1.06	1.01-1.12	1.10	1.05-1.16	0.99	0.97-1.00
Sedentary Lifestyle	No	1		1		1		1		1	
	Yes	1.03	0.99-1.08	0.99	0.93-1.04	0.97	0.92-1.03	1.01	0.96-1.06	1.00	0.99-1.02
Family History of CVD	No	1		1		1		1		1	
	Yes	1.01	0.97-1.06	1.01	0.96-1.07	1.01	0.96-1.06	1.01	0.97-1.06	1.00	0.98-1.01

PR – Poisson Regression; \* - Adjusted for gender and adolescence stage;  
LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein.

mg/dL, HDL < 45 mg/dL, TG > 100 mg/dL) demonstrating the importance of evaluating the percentage of body fat in the diagnosis of overweight and obesity and its relationship with cardiovascular disease<sup>26</sup>. Obesity is associated with lipid disorders and influences the increase of cardiovascular risk. Dyslipidemias are risk factors for cardiovascular diseases, constituting the biggest factor in the development of atherosclerosis, particularly with the presence of high levels of LDL<sup>29</sup>.

Regarding hypertriglyceridemia in childhood and adolescence, triglyceride levels between 100 and 200 mg/dL is usually related to obesity, and above 200 mg/dL, usually related to genetic changes<sup>15</sup>.

The lipid profile of groups G3 and G2 were altered when compared to G1. It can be noted that G3 showed a higher percentage of adolescents with lower HDL values when compared to G1 and G2. In this evaluation we believe that the determining factor in this change is the percentage of body fat based on BMI. These data corroborate with this study in which obese adolescents have higher concentrations of total cholesterol, LDL and lower HDL concentrations<sup>30</sup>.

The prevalence of blood pressure > P90 in adolescents of Group 03 comes against the findings in the literature relating to pressure changes with increased BMI and body fat percentage<sup>31</sup>.

Another finding in this study was the relationship between nutritional status with changes in insulin and HOMA. Similarly, a study conducted in São Paulo/Brazil with adolescents aged 10 to 19 found no difference in glucose levels between the obese and normal weight groups<sup>32</sup>, but differences were found in insulin levels and the HOMA index. Insulin and the HOMA index seem to be more sensitive markers in monitoring changes in carbohydrate metabolism. Considering that the HOMA index in adolescents is directly related to the presence of cardiovascular risk factors and that they increase in the presence of obesity<sup>33</sup>, the evalua-

tion of this variable as well as the insulin concentrations should be performed for the early evaluation of cardiovascular risk in adolescents.

Another modifiable factor for cardiovascular disease risk identified in this study was related to sedentary behavior, presented by 64.8% of the adolescents. High values of this behavior were also found in the study of Tenorio et al (2010)<sup>34</sup> reaching 49.9% on weekends, unlike the study of Andaki (2013)<sup>17</sup>, where we found a relationship of sedentary behavior with anthropometric and clinical changes especially in individuals of the first stage of adolescence.

Among the non-modifiable causes of cardiovascular disease, we assessed the family history of CVD, which was reported by 44.2% of the participants. Studies show that the risk of health behavior of parents is associated with the same behavior of adolescents<sup>35</sup>.

Our findings highlight the importance of assessment and monitoring of adolescents for cardiovascular risk factors, as these can be identified at that stage of life, minimizing complications for other stages of life. Changes in habits and lifestyle are actions that should be promoted by health professionals.

## Conclusion

Cardiovascular risk factors have been observed in younger and younger individuals and are important factors to identify a population at risk.

In this study we could observe that the identification of risk factors in adolescents can contribute to a reduction of future cardiovascular disease. Excess of weight and body fat was associated with biochemical changes related to cardiovascular risks. Thus it is critical that adolescents are routinely evaluated to prevent the aggravation of biochemical and anthropometric changes, since nowadays living habits such as sedentary lifes-

type and changes in eating behavior of this population are also associated with increased cardiovascular risk.

According to these results, we should consider the possibility of developing strategies for action in the adolescent population through health proposals in school, by actions of health strategies for the family or even with the development of specialized clinics for this public.

### Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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### Author's contribution

PP Prado Junior and SE Priore were responsible for the development of the manuscript and general coordination of the study and the development of selection criteria Articles and writing the article. Employees FR Faria, ER Faria, and SCC Franceschini were responsible for helping in the discussion, interpretation of prepared topics and critical review of the manuscript as a whole. Finally, SE Priore contributed to critical revision for text content, as well as review the final version of the article

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