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ASSOCIATION BETWEEN SITTING TIME AND CARDIOVASCULAR RISK FACTORS IN ADOLESCENTS: A SECTIONAL STUDY

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ABSTRACT

The present study aimed to analyze the association between sitting time and cardiovascular risk factors in Brazilian adolescents. The sample consisted of 1,777 adolescents (927 female). Sitting time was assessed by the Bouchard record. The risk factors evaluated were systolic blood pressure (SBP), diastolic blood pressure (DBP), and waist circumference (WC). The descriptions of continuous data are presented in values of mean and standard deviation. Student t test for independent groups. To verify the association between sitting time and measures of interest, multiple linear regression was applied. For data analysis, the statistical package SPSS version 22.0 was used and the significance was set at $p<0.05$. For males, a positive association was found between sitting time and SBP ($\beta=0.136$; $p<0.001$), DBP ($\beta=0.073$; $p<0.001$), and WC ($\beta=0.086$; $p<0.001$). After adjusting the sitting time by age, a significant positive association was found between sitting time and SBP ($\beta=0.126$; $p<0.001$) and WC ($\beta=0.077$; $p<0.001$). For females, no statistically significant associations were observed between sitting time and cardiovascular risk factors. It can be concluded that the time spent sitting in male adolescents negatively affects the cardiovascular risk factors analyzed, and to minimize future health risks, it is important to develop strategies aimed at reducing sitting time.

Key words: Abdominal fat. Blood pressure. Risk factors. Sedentary behavior.

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RESUMO

Associação entre tempo sentado e fatores de risco cardiovascular em adolescentes: estudo transversal

O presente estudo teve como objetivo analisar a associação entre tempo sentado e fatores de risco cardiovascular em adolescentes brasileiros. A amostra foi composta por 1.777 adolescentes (927 do sexo feminino). O tempo sentado foi avaliado pelo recordatório de Bouchard. Os fatores de risco avaliados foram pressão arterial sistólica (PAS), pressão arterial diastólica (PAD) e circunferência de cintura (CC). As descrições dos dados contínuos foram apresentadas em valores de média e desvio padrão; teste t de Student para grupos independentes. Para verificar a associação entre o tempo sentado e medidas de interesse foi empregado regressão linear múltipla. Para análise dos dados foi utilizado o pacote estatístico SPSS versão 22.0 e significância estipulado em $p<0,05$. Para o sexo masculino foi encontrado associação positiva entre o tempo sentado e PAS ($\beta = 0,136$; $p<0,001$), PAD ($\beta=0,073$; $p<0,001$) e CC ($\beta=0,086$; $p<0,001$). Após ajuste do tempo sentado pela idade, foi encontrada associação positiva significativa entre o tempo sentado e PAS ($\beta=0,126$; $p<0,001$) e CC ($\beta=0,077$; $p<0,001$). Para o sexo feminino não foi observado associação estatisticamente significativa entre o tempo sentado e os fatores de risco cardiovascular. Pode-se concluir que o tempo despendido sentado em adolescentes do sexo masculino afeta negativamente os fatores de risco cardiovascular analisados, sendo importante a elaboração de estratégias visando a diminuição do tempo sentado com o objetivo de minimizar futuros riscos à saúde.

Palavras-chave: Comportamento sedentário. Fatores de risco. Gordura abdominal. Pressão Arterial.

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INTRODUCTION

Data show that approximately 24.7% of the Brazilian population present systemic arterial hypertension (SAH) (Ministério da Saúde, 2019), with 14% of deaths from cardiovascular diseases in Brazil directly associated with SAH (Malachias et al., 2016).

SAH has been observed since childhood as a cardiovascular risk factor (Dwyer et al., 2013). In recent years, the prevalence of SAH has increased from 3% to 5% in children and adolescents (Amritanshu et al., 2015).

In addition, research shows that higher blood pressure values in childhood correlate with high blood pressure (BP) in adulthood, this association being of greater magnitude in older children and adolescents (Theodore et al., 2015; Chen, Wang, 2008).

This fact is a warning, since high BP levels are associated with the development of cardiovascular diseases and the risk of premature mortality (Chen, Wang, 2008).

Although arterial hypertension is reported as the main risk factor for cardiovascular events, the literature presents other indicators related to cardiovascular health, among them: body weight control, regular physical activity, glycemic control, not smoking, adequate diet, and blood cholesterol control (Wang et al., 2019; Kim et al., 2019).

An important indicator of cardiovascular risk is the high concentration of fat, especially in the abdominal region (Santos et al., 2019; Fraporti, Scherer, Goulart, 2019).

In a systematic review, Canabrava et al., (2019) report that sedentary behavior (SB) also presents itself as a cardiovascular risk factor, influencing the pediatric population.

SB is characterized by a set of activities performed in a sitting, lying, or reclining position that require energy expenditure below 1.5 METs (Dwyer et al., 2013).

The literature shows that high daily time spent in SB increases the risk of mortality from all causes and mortality from cardiovascular diseases (CVD) (Van Der Ploeg et al., 2012).

Although there is a certain understanding regarding the relationship between SB and cardiovascular risk factors, gaps are still presented regarding specific types of SB, among them, sitting time.

Therefore, there is a need to understand the relationship between SB patterns and cardiovascular risk factors in adolescents, especially sitting time.

Thus, the present study aimed to assess the association between sitting time and cardiovascular risk factors (blood pressure and waist circumference) in adolescents.

MATERIALS AND METHODS

DESIGN

The study presents a cross-sectional design. It was carried out from August 2010 to June 2011, with adolescents enrolled in classes from the sixth grade of elementary school to the second year of high school in public schools, day classes, in the city of Curitiba (PR).

The adolescents received an assent form and their parents received a consent form, explaining the objectives and procedures of the research, to be completed and signed.

The details of the sample design were previously described (Bozza et al., 2016), with the sample of the present study comprising 1,777 individuals (927 female).

The methodological procedures of this study were approved by the Research Ethics Committee of the Health Sciences Sector of the Federal University of Paraná (UFPR) and are in accordance with the ethical standards established by the Resolution of the National Health Council 196/96 under registry CAAE 04414712.3.0000.0102

SITTING TIME

Sitting time was evaluated by the Bouchard et al., (1983) three-day record (2 days a week: Tuesday and Thursday and 1 weekend day: Sunday), consisting of nine categories: 1 (sleep), 2 (sitting activities); 3-5 (light activity); 6-8 (moderate activity), and 9 (vigorous activity), which are divided into periods of 15 minutes. In this self-report recall, the adolescent fills out information regarding the activities carried out during specific periods of time. The instrument was completed in the classroom with guidance from the researcher.

The adolescents were instructed to record the type of activity performed in each 15-minute period throughout the 24 hours of the day. The registration of the information was related to the week prior to the application of the test. The use of the three-day record to assess sitting time has been previously reported (Santos et al., 2020).

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ANTHROPOMETRY

To evaluate body mass, a portable digital reading scale (WISO, model W721®) was used with a resolution of 100g, and for height a portable stadiometer (WCS - Compactcom model) with a 0.1 cm precision. Waist circumference was measured at the midpoint between the last costal arch and the iliac crest (Freedman et al., 1999).

To calculate the body mass index (BMI), the division of body weight (kg) by height (m) squared was used. The classification of BMI into eutrophic, overweight, and obese was performed according to Cole's classifications (Cole et al., 2007).

BLOOD PRESSURE

Blood pressure was measured by the auscultatory method using a stethoscope and sphygmomanometer from the Premium® brand (Accumed LTDA, Rio de Janeiro), following the parameters established by the National High Blood Pressure Education Program (2005).

Before the measurement, the circumference of the subject's arm was measured, to choose the appropriate cuff size. Two readings were performed with an interval of 5 minutes, considering the mean value between the two measurements. If the measurements differed by more than 2 mmHg, the protocol was repeated (NHBPEP, 2005).

Following the consensus of the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents (NHBPEP, 2005), values of systolic blood pressure and/or diastolic blood pressure ≥ 95th percentile were used as the cut-off point for arterial hypertension and, for pre-hypertension, values <95th percentile and ≥ 90th percentile, according to sex, age, and the height percentile. Furthermore, individuals with blood pressure values> 120/80 mmHg were considered as pre-hypertensive (NHBPEP, 2005).

STATISTICAL ANALYSIS

The normality of data distribution was verified by the Kolmogorov Smirnov test. The descriptions of the continuous data are presented in values of mean and standard deviation. The comparison between sexes for continuous data was performed using the Student t test for independent groups. The description of categorical variables was obtained from the relative frequency distribution and the chi-square test was used to compare prevalences. To verify the association between sitting time and measures of interest, multiple linear regression was used. Model 1 – crude; Model 2 - adjusted for age. For data analysis, the statistical package SPSS version 22.0 was used and the significance level was set at $p<0.05$.

RESULTS

Table 1 presents the general characteristics of the sample. The sample consisted of 1,777 individuals (927 female). The males presented higher and statistically significant values compared to the girls regarding the variables: height, body mass, waist circumference, and SBP ($p<0.01$).

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Table 1 - Characteristics of the study participants (n = 1.777).

	Boys n = 850		Girls n = 927		t	P
	Mean	DP	Mean	DP		
Age, years	14.3	1.6	14.2	1.6	1.4	0.15
Height (cm)	163.5	13.5	158	7.0	13.4	0.00*
Weight (kg)	56.0	14.4	52.2	10.7	6.3	0.00*
BMI (Kg/m^2)	20.6	3.8	20.7	3.6	-1.0	0.29
Eutrophic	665	78.2%	733	79.1%		
Overweight	133	15.6%	164	17.7%		
Obese	52	6.1%	28	3.0%		
WC (cm)	70.3	9.1	67	7.9	8.3	0.00*
SBP (mmHg)	113.0	12.8	108.9	10.6	7.1	0.00*
DBP (mmHg)	71.9	9.0	71.4	8.2	1.4	0.15
Normal BP (<90th)	534	62.8%	644	69.5%		
High normal BP (90th-95th)	140	16.5%	131	14.1%		
High BP (>90th)	175	20.6%	151	16.3%		
Sitting time (min/day)	535.3	163.2	533.5	147.9	0.23	0.81

Subtitle: Body mass index (BMI); Waist circumference (WC); Systolic blood pressure (SBP); Diastolic blood pressure (DBP); Blood pressure (BP); Standard deviation (DP); Data expressed in percentage (¥); Number of participants (n) Significance p<0,05.

Table 2 presents the values of the associations between sitting time and cardiovascular risk factors stratified by sex. For males, a significant positive association was found between sitting time and SBP (β = 0.136; p<0.001), DBP (β = 0.073; p<0.001), and waist circumference (β = 0.086; p<0.001). After adjusting the sitting time by age, a significant positive association was found between sitting time and SBP (β=0.126; p<0.001) and waist circumference (β=0.077; p<0.001). For the female sex, no statistically significant associations were observed between sitting time and the evaluated cardiovascular risk factors.

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Table 2 - Association between sitting time and cardiovascular risk factor.

	Boys					
	SBP		DBP		WC	
	β	p	β	p	β	p
Sitting time						
Model 1	0.13	0.001	0.07	0.03	0.08	0.01
Model 2	0.12	0.001	0.06	0.05	0.07	0.02
	Girls					
	SBP		DBP		WC	
	β	p	β	p	β	p
Sitting time						
Model 1	0.01	0.72	0.002	0.94	-0.01	0.76
Model 2	0.02	0.70	0.003	0.92	-0.007	0.82

Subtitle: Model 1: Regression model without adjusted; Model 2: Additional adjustment for age; Systolic blood pressure (SBP); Diastolic blood pressure (DBP); Waist circumference (WC).

DISCUSSION

The current study aimed to evaluate the association between sitting time and cardiovascular risk factors in adolescents. The main results found point to a positive association between sitting time and blood pressure and waist circumference for boys, with no significant associations found for females.

Significant associations were observed between systolic and diastolic blood pressure with sitting time in males, corroborating the findings of Oliveira et al., (2018), who found a positive association between sitting time and high blood pressure in boys.

Sivanesan et al., (2020) suggest that the high volume of sitting time in males is due to them spending more time watching TV.

Regarding female adolescents, no significant associations were observed between sitting time and systolic or diastolic blood pressure.

Similar to the present study, Moraes et al., (2013) showed a positive association between SB and increased SBP only in boys, with no statistically significant association identified in girls. In contrast, Ekelund et al., (2006) found significant associations between sitting time and systolic and diastolic blood pressure.

Gopinath et al., (2012) evaluated the association between different types of SB (playing video games, watching TV, and screen time) and blood pressure in adolescents and found a positive association between sitting time and DBP. The authors also observed an inverse relationship between sitting time spent on reading and SBP and DBP.

Excessive time in SB can trigger a series of organic disorders, which are related to elevated SBP. SB decreases the volume of nitric oxide circulating in the bloodstream, generating a lower response of arterial compliance, since it decreases the endothelial response and increases the relative hyperemia, which refers to a volume of blood accumulated in the extremities or capillaries, hindering the blood dynamics (Tremblay et al., 2010).

Tremblay et al., (2010) point out that other metabolic disorders arising from excess SB can also influence blood pressure values.

In addition, the association between SB and increased BP may be associated with factors such as eating habits, since it has been reported in the literature that approximately 35% of the total daily caloric consumption of

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children and adolescents occurs in front of the TV, and many of these foods contain high amounts of sodium, sugar, and fat, which can impact the pressure levels of adolescents (Matheson et al., 2004).

When analyzing the associations between sitting time and waist circumference, the present study found a significant positive association only in males.

Our results support the findings of Saunders et al., (2013) who found positive associations between sitting time and higher WC in boys. In addition, unlike the present study, a positive association was observed for girls, associating TV time with increased WC, BMI z score, and cardiometabolic risk. One of the possible explanations for the association between sitting time and elevated WC is that the high sitting time during free time favors a positive energy balance, since in addition to the low energy expenditure while sitting, this also correlates to an inadequate diet and, consequently, an increase in body fat.

Tremblay et al., (2011) demonstrate that SB is a risk factor for cardiovascular events regardless of physical activity.

SB encompasses different types of behavior, including sitting time, which includes actions such as leisure activities, watching TV, listening to music, reading, using the computer, and playing video games, among others (Pate, O'neill, Lobelo, 2008).

Oliveira and Guedes (2016) in their systematic review demonstrated that adolescents with metabolic syndrome have longer screen time compared to healthy adolescents.

Analyzing the relationship between sedentary behavior, physical activity, and excess body weight, Franceschin and Veiga (2020) observed that adolescents who met the recommendations of 60 minutes/day of moderate to vigorous physical activity and watched TV> 2 hours/day were more likely to be overweight than adolescents who met the recommendations for physical activity, but with <2 hours of daily screen time. These findings confirm the hypothesis that SB is significantly associated with overweight regardless of physical activity.

The findings of the present study strengthen the body of evidence on a little studied topic, which is the association between sitting time and cardiovascular risk in adolescents, since the majority of studies are based on the total time of SB or screen time. With respect to limitations, the cross-sectional design does not allow a cause and effect relationship to be established between the variables analyzed.

In addition, although self-reported methods have proven validity and are widely used to assess physical activity and sedentary behavior in adolescents, these methods are susceptible to the subject's memory bias.

In addition, although the Bouchard et al., (1983) recall diary includes a category that evaluates the daily time spent sitting, it was validated to assess physical activity and not sedentary behavior and should be considered as a limitation of the present study.

Regarding the strengths, we highlight the sample size and the evaluation of a specific type of sedentary behavior, sitting time. It is suggested that further studies be carried out in order to establish the relationship between sitting time and other cardiovascular and metabolic risk factors in the pediatric population.

CONCLUSION

From the results presented, it can be seen that sitting time is positively associated with the analyzed cardiovascular risk factors (SBP, DBP, and WC).

Thus, a reduction in daily sitting time should be encouraged, and interruptions in SB with active pauses could be a viable strategy to avoid excessive sitting time in a continuous manner in order to minimize the risks resulting from cardiovascular events.

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