

## Does the type of sedentary behaviors influence blood pressure in adolescents boys and girls? A cross-sectional study

Será que o tipo de comportamento sedentário influencia a pressão arterial em meninos e meninas adolescentes? Um estudo transversal

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**Abstract** *The aim of this study was to analyze the association between different sedentary behaviors and high blood pressure in adolescent boys and girls. We conducted a cross-sectional study with 6,264 Brazilian adolescents (14 to 19 years old). Demographic data, obesity indicators and blood pressure, were evaluated. Time spent in the sedentary behaviors (television viewing, playing video games, using the computer, non-screen sitting and, total time sitting) were also assessed. The girls spent more time watching television than boys, whereas boys spent more time using computers and video games (12.7% vs. 7.4%,  $p < 0.001$ ) than girls. Boys who watched more than four hours of television presented higher odds to give high blood pressure after adjustments for physical activity level, body mass index, age and educational level of mother (OR = 2.27,  $p < 0.001$ ). In girls, we did not find a relation between sedentary behaviors and high blood pressure ( $p > 0.05$ ). Television viewing time is associated with high blood pressure only boys. So, reduce this sedentary behavior, stimulating physical activities, might be essential to health, principally for male adolescents.*

**Key words** *Sitting time, Screen time, Health behavior, Adolescent, Blood pressure*

**Resumo** *O objetivo desta pesquisa foi analisar a associação entre diferentes comportamentos sedentários e pressão arterial elevada em meninos e meninas adolescentes, em estudo transversal com 6.264 adolescentes brasileiros (14 a 19 anos de idade). Foram avaliados dados demográficos, indicadores de obesidade e pressão arterial, assim como o tempo gasto em comportamentos sedentários (assistir televisão, jogar videogame, usar o computador, e o tempo total sentado). As meninas passaram mais tempo vendo televisão do que os meninos, enquanto estes usaram mais computadores e jogos de videogame (12,7% vs. 7,4%,  $p < 0,001$ ) do que elas. Meninos que assistiram mais de quatro horas de televisão apresentaram maior probabilidade de ter pressão arterial elevada após os ajustes pelo nível de atividade física, índice de massa corporal, idade e nível de instrução da mãe (OR = 2,27,  $p < 0,001$ ). Com as meninas não foi observada uma relação entre comportamentos sedentários e pressão arterial elevada ( $p > 0,05$ ). O tempo assistindo televisão esteve associado com a pressão arterial elevada apenas entre os meninos. Assim, reduzir o comportamento sedentário, estimulando atividades físicas, pode ser essencial para a saúde, principalmente para adolescentes do sexo masculino.*

**Palavras-chave** *Tempo sentado, Tempo de tela, Comportamento de saúde, Adolescentes, Pressão arterial*

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## Introduction

High blood pressure (HBP) is a major risk factor for several cardiovascular diseases including coronary artery disease and stroke<sup>1</sup>, affecting between 2.5 and 17.3%<sup>2</sup> of adolescents. As HBP is associated with atherosclerosis development in youth<sup>3</sup>. Besides, HBP in childhood was strongly related to increased rates of premature death from endogenous causes in adults<sup>4</sup>.

Formally, sedentary behavior (SB) refers to any waking behavior with low energy expenditure ( $\leq 1.5$  METs) while in a sitting or reclining posture<sup>5</sup>. Based on this description and epidemiological data, the literature shows that the prevalence of SB is increasing in Brazil and It, probably, is a reflex of technological advances. Currently, 35.7% of Brazilian adolescents, with more than 14 years old, spend, on average, for 3 hours or more per day, watching television<sup>6</sup>, what characterize the presence of SB in this population.

Although, overweight and low physical activity level have an association with sedentary behaviors in adolescents<sup>7,8</sup>, the relationships with HBP in this group still controversial. Previous studies showed that screen time<sup>5,7</sup> was related to HBP in adolescents, while other studies have not observed any significant association between screen time<sup>8,9</sup>. Moreover, other sedentary behaviors as total time sitting or spending in non-screen activities are not explored in the literature<sup>10</sup>.

In fact, SB and prevalence of HBP might have a dependence of sex<sup>11</sup>. Previous studies<sup>12-14</sup> have shown that boys are more sedentary than girls, particularly in sitting time to play video games and to use the computer on weekends. About HBP, boys have a higher prevalence than girls<sup>15</sup>.

However, it remains less clear if the association between the sedentary behavior and HBP is also different between sexes. Differences between gender behaviors should be considered, since they can be different associations with HBP<sup>16,17</sup>. Thus, the aim of this study was to analyze the association between SB and HBP in adolescents.

## Material and methods

### Study design and sample

This study is cross-sectional, approved by The Ethical Committee of The University of Pernambuco in compliance with the Brazilian National Research Ethics System Guidelines. The

target population was limited to high school students between 14 and 19 years old. Participants are from the public education system in the State of Pernambuco (Northeast of Brazil), which encompasses approximately 80% of all students attending this level of schooling.

The following parameters were used to calculate sample size: 95% of confidence interval; a maximum tolerable error of 2 percentage points; design effect ( $deff$ ) = 2; and, because this study comprehended the analysis of multiple risk behaviors and different frequencies of occurrence, the estimated prevalence was 50%. Additionally, to minimize the limitations caused by eventual losses in the application and/or inadequate completion of the questionnaires, it was decided to add 20% to the sample size.

An attempt was made to ensure that the distribution of students in the sample was balanced concerning the geographical allocation of students, school size and the period of the day that students attended school. The number of students enrolled in each of the 17 school districts, which are political organizations responsible for managing schools belonging to their territory, determined the Geographical distribution. We divided School size into three categories according to the number of students attending each high school as follows: small,  $< 200$ ; medium, 200 to 499; and large,  $\geq 500$  and period of the day that students attended school in two categories: daytime and evening.

After, we selected the required sample performing a two-stage cluster sampling procedure. In the first stage, there was the stratification of schools by the school district. In the second stage, there was the stratification by class size and period of the day. We randomized participants using SPSS/PASW version 20 (IBM Corp, NY, USA), and the sampling unit for the final stage of the process was the class. All of these procedures to determine the sample have been described previously by Magalhães *et al.*<sup>18</sup>.

### Data collection

Data collection was performed between May and October in 2011 during the period of the day that the adolescents were in class (morning, afternoon and evening). Socioeconomic and demographic characteristics were obtained using an adapted version of the Global School-based Student Health Survey<sup>19</sup>. Also, we performed the blood pressure evaluation and anthropometry.

## Outcome

### High Blood pressure

Blood pressure was measured using the Omron HEM 742 (Omron Corporation, Kyoto, Kansai, Japan)<sup>20</sup> after the adolescents rested and remained seated with legs uncrossed for 5 minutes. We used the appropriate cuff size for each subject. All blood pressure measurements were performed three times on the right arm placed at heart level in a seated position, with the interval of 1 minute between the measures. We used the mean value of the last two measurements<sup>21</sup>. High blood pressure was defined as systolic and/or diastolic blood pressure equal or higher than the reference sex, age, and height-specific 95<sup>th</sup> percentile<sup>22</sup>.

### Independent variables

#### Sedentary behaviors

The predictors in the present study were components of time spent in sedentary behavior, including television viewing, playing video games, using the computer and non-screen activities (talking to friends, playing cards or dominoes, talking on the phone, driving, or as a passenger, reading or studying). The mean time spent in each of these behaviors (in a typical week) was asked separately for weekdays and weekends, assigning weight 5 to weekdays and weight 2 to weekends and dividing the result by 7 to obtain the mean time in minutes per day<sup>14</sup>. Screen entertainment time is the sum of the weighted mean screen time (television + video game + computer). Total time sitting was a sum of screen entertainment and time sitting in other activities (talking to friends, playing cards or dominoes, talking on the phone, driving, or as a passenger, reading or studying). We followed given that the American Academy of Pediatrics<sup>23</sup> recommendation and categorized all sedentary behavior in three groups: less than 2 hours per day, 2 to 4 hours and more than 4 hours per day of exposure.

Reproducibility indicators (i.e., test-retest consistency, one-week apart) showed the Spearman's rank correlation coefficient of 0.60 (weekdays) and 0.78 (weekends) for television viewing, 0.62 (weekdays) and 0.78 (weekends) for using the computer or video games and 0.42 (weekdays) and 0.56 (weekends) for non-screen activities.

## Confounders

### Physical activity

The participants reported their level of physical activity answering the questions: 'During the past week, how many days were you did exercise with a duration of 60 minutes or more?' and, 'During a typical week, how many days you did exercise with a duration of 60 minutes or more?'. The average of both questions was considered to determine the level of physical activity. We classified the participants as physically active (threshold of five or more days per week with at least 60 minutes per day of moderate to vigorous physical activity) or insufficiently active<sup>24</sup>.

### Anthropometric variables

We weighed the adolescents without shoes and coats on an electronic scale (model Sport), and the height was measured using a stadiometer. Overweight was determined by body mass index above the 85<sup>th</sup> percentile for their sex and age according Cole et al.<sup>25</sup>.

### Sociodemographic variables

Sociodemographic variables were gender), age, race, place of residence (Urban and Rural), occupation (work and not work), maternal education ( $\leq$  eight years of study and  $>$  8 years of study) were obtained.

### Statistical analysis

Data entry was conducted using the EpiData software package. Electronic data control was ensured using the 'CHECK' function. We repeated the data entry and corrected the errors using the duplicate file comparison function. Data analysis was conducted using Statistical Package for the Social Sciences for Windows.

Data analysis included descriptive statistics (frequency distribution) and measures of association (Pearson chi-square and binary logistic regression). Binary logistic regressions were carried out to analyze whether HBP has association with each sedentary behavior (television viewing time, playing video games, using the computer and non-screen activities). Thus, for each sedentary behavior we conducted a regression model, and adjusted for physical activity level, status weight and other confounders variables ( $p < 0.20$  in bivariate analyses), all being introduced simultaneously. We also performed the tests for interaction effects and the results are shown as crude and adjusted odds ratio (OR) values and 95% con-

fidence intervals (CIs). The Hosmer-Lemeshow test was used to assess the model goodness-of-fit.

## Results

The research group visited eighty-five schools in 48 cities in the State of Pernambuco (in the northeast region of Brazil). In the selected schools, we interview a total of 7,195 students, but 919 participants were out of the target age group ( $\leq 13$  or  $\geq 20$  years), and 12 questionnaires had inconsistent data and incompleteness. Thus, the total sample has 6,264 adolescents (59.7% girls) adolescents with a mean age of  $16.6 \pm 1.2$  years. Table 1 present the sociodemographic characteristics of the study group.

The prevalence of adolescents classified as insufficiently active was higher in girls ( $p < 0.001$ ). Overweight was present in 16.5% of the partici-

pant and was similar between sexes. Girls spent more time on television viewing and sitting time except entertainment screen time, while boys spent more time on video games and computers and presented a higher total time sitting ( $p < 0.05$ ) (Table 2).

Tables 3 and 4 show associations between sedentary behaviors and demographic data in boys and girls, respectively.

There was an interaction between sexes and sedentary behaviors ( $p < 0.001$ ); therefore, regression analyses were performed separately for sex (Table 5). The crude analysis showed that in television viewing time was positively associated with high blood pressure, only in boys. This association remained significant after adjustment for physical activity level, overweight, place of residence and educational level of the mother. There was a linear increase in the prevalence of HBP with television viewing time in boys;  $< 2$  hours

**Table 1.** Study participants' demographic and socioeconomic characteristics by sex.

Variable	Boys (n=2524)		Girls (n=3737)		Total (n=6264)		p-value
	n	%	n	%	n	%	
Age group (years old)							<0.001*
14 to 15	460	34.1	890	65.9	1350	21.6	
16 to 17	1353	40.5	1991	59.5	3344	53.4	
18 to 19	711	45.4	856	54.6	1567	25.0	
Employment status							<0.001
Yes	804	57.9	584	42.1	1388	22.2	
No	1713	35.3	3143	64.7	4856	77.8	
Television at home							0.189
Yes	2494	40.4	3678	59.6	6175	98.7	
No	28	33.3	56	66.7	84	1.3	
Compute at home							<0.001
Yes	1177	45.8	1394	54.2	2571	41.1	
No	1343	36.5	2340	63.5	3686	58.9	
Computer with internet at home							<0.001
Yes	984	46.0	1157	54.0	2141	34.3	
No	1531	37.3	2573	62.7	4107	67.7	
Ethnicity							0.411
White	667	41.2	953	59.8	1620	26.0	
Nonwhite	1848	39.0	2771	59.0	4619	74.0	
Place of residence							0.938
Urban	1878	39.4	2766	58.6	4644	74.5	
Rural	640	39.3	947	58.7	1587	25.5	
Maternal education							<0.001
$\leq 8$ years of study	1324	38.0	2164	62.0	3488	64.7	
$> 8$ years of study	864	44.4	1039	53.6	1903	35.3	

\* Test for linear trend.

**Table 2.** High blood pressure, physical activity level, body mass index and sedentary behaviors by sex.

Variables	Boys (n = 2524)		Girls (n = 3737)		Total (n = 6264)		p-value
	n	%	n	%	n	%	
High blood pressure							< 0.001
Yes	251	10.4	191	5.2	442	7.3	
No	2169	89.6	3464	94.8	5633	92.7	
Physical activity level							< 0.001
Active	1103	43.9	1088	29.2	2191	35.1	
Insufficient activity	1411	56.1	2634	70.8	4045	64.9	
Status weight							0.918*
Eutrophic	2034	84.1	3038	83.1	5072	83.5	
Overweight	264	10.9	478	13.1	742	12.2	
Obesity	121	5.0	141	3.9	262	4.3	
Television viewing							0.024*
< 2 hours	1231	48.9	1727	46.4	2958	47.4	
2 to 4 hours	977	38.8	1482	39.8	2459	39.4	
> 4 hours	310	12.3	516	13.9	826	13.2	
Playing video games and/or using the computer							< 0.001*
< 2 hours	1482	58.9	2769	74.4	4251	68.1	
2 to 4 hours	714	28.4	679	18.2	1393	22.3	
> 4 hours	320	12.7	276	7.4	596	9.6	
Non-screen activities							0.016*
< 2 hours	1162	46.7	1627	44.0	2789	45.1	
2 to 4 hours	988	39.7	1506	40.7	2494	40.3	
> 4 hours	339	13.6	568	15.3	907	14.7	
Total time sitting							0.002*
< 2 hours	218	8.8	395	10.7	613	9.9	
2 to 4 hours	509	20.5	815	22.1	1324	21.5	
> 4 hours	1750	70.6	2474	67.2	4224	68.6	

\* Test for linear trend.

for television viewing time (prevalence of HBP = 8.5%), 2-4 hours (11.0%) and > 4 hours (15.8%); (p < 0.001). For girls, we do not found associations between the different types of sedentary behaviors and HBP prevalence.

## Discussion

The main findings of this study were: 1) girls spent more time on television viewing and non-screen activities, whereas boys spent more time on video games and computers; 2) television viewing time have an association with HBP only in male group; 3) we don't found association between sedentary behaviors and HBP in girls.

The prevalence of adolescents who spent > 4 hours per day viewing television and playing video games and/or using computers were lower than observed in previous studies in developed

countries<sup>14,26,27</sup>, and are probably explained by the lower income of our sample<sup>14,26</sup>. In fact, 58.9% of the adolescents did not have a computer, and 65.7% did not have internet access contributing to this lower prevalence when compared with other studies. In the analysis of sedentary behaviors stratified by sex, we observed that girls spent more time on television viewing and non-screen activities. However, other studies noted that boys (adolescents<sup>14</sup> and children<sup>6</sup>) spent more time on video games, computers and sitting. This result reflects the entertainment preferences differences between sex.

Our study has shown that the positive association between television viewing time and HBP in boys even after adjustments. This find is in agreement with previous studies that showed a positive association between systolic blood pressure and television viewing time in children<sup>6</sup>, which was also observed in and adolescents<sup>28</sup>. In

**Table 3.** Association between sedentary behavior and demographic data in boys.

	Television viewing			Playing video games and/or using the computer			Non-screen activities			Total time sitting		
	< 2h	2 to 4h	> 4h	p	< 2h	2 to 4h	> 4h	p	< 2h	2 to 4h	> 4h	p
Age group												
14 to 15 years	37.8	46.9	16.3	<0.001*	57.4	28.3	14.3	<0.001*	45.3	39.6	15.1	0.103*
16 to 17 years	50.4	38.7	10.9		55.8	29.8	14.4		45.0	40.9	14.1	
18 to 19 years	53.2	34.4	12.4		63.8	27.7	8.5		50.8	37.5	11.7	
Employment status												
Yes	56.5	35.2	8.3	<0.001\$	71.6	20.4	8.0	<0.001\$	53.1	36.1	10.8	<0.001\$
No	45.3	40.5	14.2		52.8	32.2	15.0		43.5	41.5	15.0	
Television at home												
Yes	48.6	39.0	12.4	0.080\$	58.6	28.6	12.8	0.054\$	46.5	39.8	13.7	0.149\$
No	70.4	22.2	7.4		81.5	11.1	7.4		64.0	33.3	3.7	
Compute at home												
Yes	49.1	38.6	12.3	0.961\$	35.9	41.9	22.2	<0.001\$	37.0	45.6	17.4	<0.001\$
No	48.6	39.0	12.4		78.9	16.6	4.5		55.1	34.6	10.3	
Computer with internet at home												
Yes	49.8	38.1	12.1	0.712\$	31.3	43.8	24.9	<0.001\$	34.8	46.7	18.5	<0.001\$
No	48.2	39.3	12.5		76.5	18.5	5.0		54.2	35.3	10.5	
Ethnicity												
White	46.2	41.3	12.5	0.286\$	56.2	30.1	13.7	0.244\$	45.3	41.2	13.5	0.675\$
Nonwhite	49.6	38.0	12.4		59.9	27.7	12.4		47.0	39.3	13.7	
Place of residence												
Urban	48.1	39.2	12.7	0.304\$	52.5	32.1	15.4	<0.001\$	43.2	41.6	15.2	<0.001\$
Rural	51.3	37.6	11.1		77.6	17.4	5.0		56.9	34.0	9.1	
Maternal education												
≤ 8 years of study	49.5	38.3	12.2	0.980\$	46.8	36.1	17.1	<0.001\$	39.1	42.8	18.1	<0.001\$
> 8 years of study	49.1	38.8	12.1		66.7	23.4	9.9		51.1	37.6	11.3	

Values are shown in percentage (%); \* p for trend; \$ p for chi-square test.

Table 4. Association between sedentary behavior and demographic data in girls.

	Television viewing			Playing video games and/or using the computer			Non-screen activities			Total time sitting		
	< 2h	2 to 4h	> 4h	p	< 2h	2 to 4h	> 4h	p	< 2h	2 to 4h	> 4h	p
Age group												
14 to 15 years	40.5	42.7	16.8	< 0.001*	67.5	21.0	11.5	< 0.001*	35.8	45.7	18.5	< 0.001*
16 to 17 years	46.7	39.8	13.5		74.1	18.9	7.0		43.5	40.1	16.4	
18 to 19 years	51.7	36.7	11.6		82.3	13.7	13.0		53.6	36.9	9.5	
Employment status												
Yes	60.7	30.7	8.6	< 0.001\$	80.9	15.7	3.4	< 0.001\$	51.5	36.6	11.9	< 0.001\$
No	43.7	41.5	14.8		73.1	18.8	8.1		42.6	41.4	16.0	
Television at home												
Yes	45.8	40.2	14.0	< 0.001\$	74.3	18.3	7.4	0.402\$	43.7	40.9	15.4	0.022\$
No	82.1	14.3	3.6		82.1	12.5	5.4		62.3	30.2	7.5	
Compute at home												
Yes	47.2	40.3	12.5	0.185\$	43.5	38.6	17.9	< 0.001\$	33.2	45.3	21.5	< 0.001\$
No	45.9	39.5	14.6		92.7	6.1	1.2		50.3	38.0	11.7	
Computer with internet at home												
Yes	47.5	40.1	12.4	0.207\$	36.3	42.9	20.8	< 0.001\$	31.0	46.5	22.5	< 0.001\$
No	45.8	39.6	14.6		91.4	7.2	1.4		49.8	38.1	12.1	
Ethnicity												
White	44.7	40.1	15.2	0.297\$	73.6	18.4	8.0	0.738\$	44.5	40.9	14.6	0.766\$
Nonwhite	46.9	39.7	13.4		74.6	18.2	7.2		43.8	40.7	15.5	
Place of residence												
Urban	46.2	38.9	14.9	0.017\$	68.0	22.6	95.4	< 0.001\$	40.9	42.0	17.1	< 0.001\$
Rural	46.2	42.5	11.3		92.7	5.8	1.5		52.3	37.2	10.5	
Maternal education												
≤ 8 years of study	43.2	42.9	13.9	0.045\$	54.6	31.7	13.7	< 0.001\$	32.6	46.2	21.2	< 0.001\$
> 8 years of study	47.5	38.5	14.0		82.0	13.2	4.8		47.6	39.0	13.4	

Values are shown in percentage (%); \* p for trend; \$ p for chi-square test.



**Table 5.** Crude and adjusted odds ratios (OR) and confidence interval (CI 95%) for the association between high blood pressure and different sedentary behaviors in boys and girls.

	High blood pressure in boys		High blood pressure in girls	
	Crude OR (CI 95%)	Adjusted OR (CI 95%)	Crude OR (CI 95%)	Adjusted OR (CI 95%)
Television viewing <sup>#</sup>				
< 2 hours	1	1	1	1
2 to 4 hours	1.34 (1.00-1.79)	1.34 (0.99-1.81)	1.24 (0.91-1.70)	1.07 (0.75-1.52)
> 4 hours	2.02 (1.39-2.93)	2.01 (1.37-2.98)	1.14 (0.73-1.79)	0.76 (0.44-1.29)
Playing video games and/or using the computer <sup>†</sup>				
< 2 hours	1	1	1	1
2 to 4 hours	0.82 (0.60-1.13)	0.97 (0.66-1.43)	0.92 (0.63-1.36)	1.05 (0.62-1.76)
> 4 hours	1.21 (0.82-1.76)	1.16 (0.70-1.92)	0.82 (0.45-1.49)	0.77 (0.34-1.70)
Non-screen activities <sup>§</sup>				
< 2 hours	1	1	1	1
2 to 4 hours	1.14 (0.86-1.51)	1.10 (0.79-1.53)	1.10 (0.80-1.51)	1.11 (0.76-1.61)
> 4 hours	0.95 (0.62-1.44)	1.00 (0.62-1.61)	1.06 (0.69-1.64)	1.14 (0.70-1.86)
Total time sitting <sup>‡</sup>				
< 2 hours	1	1	1	1
2 to 4 hours	0.92 (0.54-1.55)	1.32 (0.77-2.26)	2.37 (1.22-4.60)	1.90 (0.90-4.01)
> 4 hours	0.97 (0.61-1.54)	0.85 (0.56-1.26)	1.91 (1.02-3.56)	1.46 (0.71-2.96)

<sup>#</sup> Boys: Adjusted for physical activity level, status weight, TV at home age and employment status; Hosmer-Lemeshow test (p=0.913); Girls: Adjusted for physical activity level, status weight, TV and computer at home, placed of residence, age, maternal education, and employment status. Hosmer-Lemeshow test (p = 0.592). <sup>†</sup> Boys and Girls: Adjusted for physical activity level, status weight, compute at home, compute at home with internet, maternal education, age and employment status; Hosmer-Lemeshow test for boys (p = 0.867) and girls (p = 0.758). <sup>§</sup> Boys and Girls: Adjusted for physical activity level, status weight, TV and compute at home, compute at home with internet, maternal education, age and employment status; Hosmer-Lemeshow test for boys (p = 0.050) and girls (p = 0.755). <sup>‡</sup> Boys: Adjusted for physical activity level, status weight, compute at home, compute at home with internet, maternal education, age and employment status; Hosmer-Lemeshow test for boys (p = 0.527); Girls: Adjusted for physical activity level, status weight, compute at home, compute at home with internet, ethnicity, maternal education, age and employment status; Hosmer-Lemeshow test (p = 0.332).

a recent survey of adolescents in Southern Brazil, authors noted that high sedentary behavior (TV + computer + video game) have an association with HBP<sup>29</sup>. However, in this other study, sex was used as an adjustment variable, while these relationships were explored stratifying up the sex in the present study. The mechanisms linking television viewing and HBP are not clear, and may be related to higher food consumption during TV watching, such as processed meat, soda, and candies that have high amounts of sodium, sugar, and caffeine during watching<sup>30,31</sup>. A previous study demonstrated that boys are more susceptible to food cues in commercials than girls<sup>32</sup>. In this study, boys consumed fewer vegetables, fruits, and natural juices than girls, which corroborate partially with this hypothesis.

We analyzed the association between the time playing video games, using the computer and the non-screen activities with HBP in adolescents and we do not found an association in both sexes. One possible reason is that the use of video games, in particular for sports games, can encourage a more active behavior. Another factor is that when played actively by the actives video games can occur improvements in cardiovascular parameters<sup>33</sup>.

Regarding the sitting time, there was a high prevalence of higher sitting time to 4 hours a day in both normotensive adolescents as in with high blood pressure which may have contributed to the observed association in this variable. However, this study did not evaluate the breakdown of sedentary behavior, which is a relevant limitation



since this information has been associated with the decrease of blood pressure<sup>34</sup>.

In practical terms, our data support the American Academy of Pediatrics<sup>23</sup> recommendation that parents should limit children's viewing TV to 1–2 h per day. Therefore, developing strategies those are effective in reducing time spent in television watching may be a determining factor for effectiveness of interventions aimed at lowering blood pressure, especially in adolescent boys, due to reduced exposure to advertisements that often promote unhealthy dietary habits. Furthermore, the previous studies<sup>35,36</sup> have shown that take a short break in sitting time reduces the negative effects of sedentary behaviors in adolescents. On the other hand, for girls, other factors should be considered to reduce blood pressure instead of sedentary behavior.

The representative sample size and the fairly narrow age range are the study's strengths. Also, strict sampling procedures were established to ensure that the sample was representative of a Brazilian state population. The evaluation of

different sedentary behaviors and the control for various potential confounders has also forced this study. There are also certain limitations that need to be pointed out. The cross-sectional design and the correlative nature of the data preclude us from establishing a causal relationship between HBP and sedentary behavior. Another factor is that blood pressure was assessed in a single day, which overestimates the proportion of adolescents with HBP. The use of self-reported measures of sedentary behavior and physical activity is an important limitation that needs to be considered. However, sedentary behavior questionnaires have been widely used, and they have advantages over accelerometer, such as low cost and the possibility of analyzing different sedentary behaviors.

In conclusion, the results of this study indicate that, in a large representative sample, only television viewing time was associated with HBP in boys, while the female group there was no association between the different types of sedentary behavior and HBP.

## Collaborations

LMFT Oliveira, RM Ritti-Dias, BQ Farah, DGD Chirstofaro, MVG Barros, PRB Diniz and FJSP Guimarães participated equally in all stages of preparation of the article.

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