






Association of sex, sexual maturation, age group, economic class, and nutritional status with the different cutoff points of screen time in adolescents


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Abstract

Objectives: to estimate the prevalence of adolescents' screen time in three different scenarios and possible associations with gender, sexual maturation, age group, economic class, and nutritional status.

Methods: a cross-sectional study conducted with a representative sample of 3,979 adolescents from Greater Curitiba. Screen time (television, computer, and video game) was self-reported and categorized as ≤ 2 h/day, > 2 to ≤ 4 h/day, and > 4 h/day. Ordinal logistic regression tested the associations.

Results: the sample consisted of adolescents of 14.60 ± 1.88 years old, most girls (51.2%). The prevalence of screen time > 4 h/day was 89.3%. Girls ($OR=0.61$; $CI95\%=0.49-0.76$) and the older age groups ("14 to 16 years" $OR=0.29$; $CI95\%=0.22-0.39$, and "17 to 19 years" $OR=0.11$; $CI95\%=0.08-0.16$) were less likely to be in the groups of higher screen time.

Conclusions: screen time above four hours seems to be the most prevalent among adolescents. Older girls and teens are less likely to have higher screen time.

Key words Screen time, Age group, Social class, Nutritional status, Adolescent



Introduction

Sedentary behavior represents activities with low energy expenditure (≤ 1.5 METs) performed in the sitting or reclining position.¹ This behavior often initiated during childhood and adolescence tends to continue with advancing age and represents a potential risk factor for cardiometabolic diseases, overweight and obesity, and all-cause mortality.²⁻⁵

Time in front of a television is the most studied sedentary behavior among adolescents⁶; however, screen time is a broader construct, which also contemplates the use of the computer and video games.⁷ High prevalence of screen time in adolescents is a common issue among developed and developing countries. It reaches 74% of North American,⁸ 59.2% of Spanish,³ and 76.9% of United Kingdom adolescents.² In Brazil, several studies showed a high screen time prevalence above 50%,⁹⁻¹¹ and a recent meta-analysis observed a prevalence of 70.9%.⁵

Additionally, screen time can be explained by different factors, such as gender, sexual maturation, economic class and nutritional status,¹¹⁻¹³ however, the analyses present limitations on the cut-off points used in the definition of the high screen time. The American Academy of Pediatrics recommends no more than two hours of daily television exposure,¹⁴ however, a greater availability and need for technological resources increasingly contributes to the extrapolation of this time, which would indicate the need to identify results at more than one cut-off point, as already observed in the literature, through the distribution percentile of the sample itself¹² or even in scenarios of 2 to 4 hours and above 4 hours of exposure to screens.³

Studies should analyze screen time using a higher cutoff point or even analyze more than one cut point provided by percentiles of the sample¹² or scenarios of two, four, or more hours in front of a screen.³ Thus, this study aimed to: a) estimate the prevalence of screen time of adolescents in three different scenarios (≤ 2 hours; >2 hours and ≤ 4 hours, and >4 hours) and b) to verify the association between gender, sexual maturation, age group, economic class and nutritional status with the high screen time of adolescents.

Methods

This is a cross-sectional correlational study with a representative sample of high schooler adolescents enrolled in public schools in Curitiba and São José dos Pinhais, Paraná, Brazil. Curitiba is the capital of the state of Paraná and has a very high human development index (0.823), occupying the 10th position in the Brazilian ranking. São José dos Pinhais is part of the Curitiba

metropolitan region and is the 5th largest city in the state. It has a high human development index (0.758).¹⁵

We performed sample size calculations in two distinct stages: i) identifying the minimum sample to estimate the prevalence of the outcomes and, ii) estimating the minimum sample to test the associations. The minimum sample required for the study was 1163 adolescents, which would cover both prevalence and association objectives.

For both cities, we used a multiple-stage sampling process according to the following steps:

- 1) We listed all schools that had high school classes occurring during the morning period in both cities;
- 2) One school was drawn for each of the ten school districts of Curitiba (10 schools) and all the schools of the five urban regions from São José dos Pinhais were invited (18 schools);
- 3) We randomly selected two classes of each grade and invited all students to participate.

Before data collection, we received an authorization from the State Department of Education, from school principals, adolescent's parents or guardians (consent form), and from the adolescents (assent form). The study followed the research standards involving human beings established by the National Health Council (resolution 466/2012), and the Research Ethics Committee of the Federal University of Paraná approved this study (CAAE: 97392818.1.0000.0102). Previously trained staff of the Research Center on Physical Activity Health - CEAHS/UFPR performed the data collection.

We invited a total of 4,497 adolescents. A hundred and sixty-six adolescents did not deliver the consent form or refused to participate. We excluded from the data analysis adolescents who presented physical limitations ($n=8$), who were outside the age groups of interest ($n=142$), who filled out the questionnaire incorrectly ($n=102$) or incomplete ($n=100$). Therefore, the study's final sample included 3,979 adolescents from 11 to 19 years of age, resulting in a response rate of 88.5%.

We performed a sample size calculation *a posteriori* to check the sample's statistical power. Considering an α of .05, a β of .20, and the prevalence for each sedentary behavior outcome observed in the present study, our sample can identify risky odds ratios above 1.19 and protective odds ratios of .84 in prevalence above 44% for >4 hours/day of screen time.

The adolescents answered a questionnaire containing information about gender, age group, economic class, and screen time. We also measured weight and height and collected a self-evaluation of sexual maturation. We

grouped the adolescents in three age groups (11 to 13, 14 to 16, and 17 to 19 years old).

The adolescents performed a self-evaluation of sexual maturation stages comparing their pubic hairiness with printed images.^{16,17} Thus, the adolescents were grouped in prepubescent (stage 1), pubescent (stages 2, 3, and 4), and postpubescent (stage 5) according to the Tanner's¹⁸ method.

We used the number of goods available at home, the presence of a monthly employee in the adolescent's residence, and the educational level of the parent primarily responsible for most of the family's financial earnings to assess the adolescent's economic class (EC).¹⁹ We classified EC as class A (High), class B (middle), and class C (low).

To assess nutritional status, first we measured total body mass, with a portable digital scale by PLENNA (Acqua model, São Paulo, Brazil), with a 100g resolution. Then, height was measured with a metric tape attached to the wall, with 0.1 cm accuracy. Then, Body mass index (BMI) was calculated as weight (Kg)/height (m), and the BMI classification Status followed the reference proposed by the World Health Organization for each sex and age.²⁰

The Brazilian version^{7,21} of the Adolescents Sedentary Activity Questionnaire (ASAQ) assessed the screen time. The ASAQ has adequate validity, and reliability (CCI=0.90, CI95%=0.86-0.93)⁷ to measure sedentary activities in Brazilian adolescents. The screen time consisted of time (hours/day) spent watching television, movies, using a computer, and playing video games. Adolescents were categorized as: ≤ 2 hours/day, >2 to ≤ 4 hours/day, and >4 hours/day in screen time.

We used descriptive analysis (absolute and relative frequencies) to characterize the sample. The chi-square test compared the frequencies of the independent variables between the three levels of screen time.

Ordinal logistic regressions verified associations of gender, sexual maturation, age group, economic class, and nutritional status with the screen time. We obtained unadjusted and adjusted odds ratios (OR) with 95% confidence intervals (CI95%). The Brant test analyzed the assumption of proportionality of odds ratios, and, in the case of violation of this assumption, we presented odds ratios for all possibilities of association. All analyses were performed in Stata (15.1, StataCorp LLC, College Station, TX), adopting $p < 0.05$ as a significance level.

Results

The final sample consisted of 3,979 adolescents with 14.60 ± 1.88 years old (Boys: 14.63 ± 1.86 years old; Girls: 14.57 ± 1.89 years old). Most were girls (51.2%), pubescent (74.9%), with 14 to 16 years old (50.6%), from an economic class B (54.1%), and had normal weight (69.4%). The screen time >4 hours/day was the most prevalent behavior

for the overall sample (89.3%) and across all variables with prevalence ranging from 73.2% (17 to 19 years old) to 96.6% (prepubescent) (Table 1).

Crude associations

Girls (OR=0.64; CI95%=0.52-0.79), postpubescent adolescents (OR=.77; CI95%=0.61-0.97), adolescents with 14 to 16 years old (OR=0.29; CI95%= 0.22 - 0.39) and 17 to 19 years old (OR=0.11; CI95%=0.08-0.15), were less likely to be in the higher groups of screen time (>2 to ≤ 4 hours/day + >4 hours/day in screen time). Prepubescent adolescents were more likely to be in the higher groups of screen time (OR=4.35; CI95%=1.18-13.73) (>2 to ≤ 4 hours/day + >4 hours/day in screen time) (Table 2).

Adjusted associations

After adjustments, girls (OR=0.61; CI95%=0.49-0.76) and adolescents with 14 to 16 years old (OR=0.29; CI95%=0.22-0.39) and 17 to 19 years old (OR=0.11; CI95%=0.08-0.16) remained less likely to be in the higher groups of screen time (>2 to ≤ 4 hours/day + >4 hours/day in screen time). The adjusted analysis showed that sexual maturation did not remain associated with screen time (Table 2).

Discussion

The study aimed to estimate the prevalence of screen time in adolescents in three different scenarios (≤ 2 h/day; >2 to ≤ 4 h/day, and >4 h/day) and verify the association between gender, sexual maturation, the age group, economic class and body mass index with the adolescents' high screen time. Our results showed that 89.3% of the adolescents spent more than 4h/day in front of a screen, and this high prevalence was similar across gender, sexual maturation, age group, economic class, and nutritional status. We also found that girls and older adolescents were less likely to have higher in screen time compared to their peers.

Regarding the prevalence of screen time, most above 4 hours daily is in agreement with results observed in systematic reviews that indicate prevalence higher than 50%.^{4,5,9,10} However, it is difficult to compare results due to a lack of standardization of screen time cutoff points (if high time >2 hours or >4 hours or other cutoff points) and whether screen time considers only exposure to television or also include others screen-based technologies (television, computer, and video games). A recent meta-analysis⁵ observed a prevalence of 70.9% of more than 2 hours a day in front of the television, computer, or video games; however, the high screen time cutoff point is based on the American Academy of Pediatrics¹⁴ recommendation, which refers only to the in television time. As mentioned before, such a cutoff point

Table 1

	Overall		Screen time						P
			≤2h/day		>2 a ≤4h/day		>4h/day		
	n	%	n	%	n	%	n	%	
Overall	3979	100.0	342	8.6	84	2.1	3553	89.3	
Sex									
Male	1940	48.8	133	6.9 ^a	33	1.7 ^{a b}	1774	91.7 ^b	0.001
Female	2039	51.2	209	10.3 ^a	51	2.5 ^{a b}	1779	87.2 ^b	
Sexual maturation									
Pubescent	2982	74.9	246	8.2 ^a	62	2.1 ^a	2674	89.7 ^a	0.008
Prepubescent	118	3.0	3	2.5 ^a	1	0.9 ^{a b}	114	96.6 ^b	
Postpubescent	879	22.1	93	10.6 ^a	21	2.4 ^{a b}	765	87.7 ^b	
Age group (years)									
11 - 13	1509	37.9	36	2.4 ^a	23	1.5 ^b	1450	96.1 ^c	0.001
14 - 16	2012	50.6	207	10.3 ^a	37	1.8 ^b	1768	87.9 ^b	
17 - 19	456	11.5	99	21.6 ^a	24	5.2 ^a	335	73.2 ^b	
Economic Class									
High	446	11.2	34	7.6 ^a	9	2.0 ^a	403	90.4 ^a	0.305
Intermediate	2152	54.1	181	8.4 ^a	48	2.2 ^a	1923	89.4 ^a	
Low	1381	34.7	127	9.2 ^a	27	2.0 ^a	1227	88.8 ^a	
Nutritional Status									
Normal weight	2760	69.4	240	8.7 ^a	57	2.1 ^a	2463	89.2 ^a	0.846
Low weight	129	3.2	7	5.4 ^a	1	0.8 ^a	121	93.8 ^a	
Overweight	702	17.6	68	9.7 ^a	14	2.0 ^a	620	88.3 ^a	
Obese	388	9.8	27.0	7.0 ^a	12	3.1 ^a	349	89.9 ^a	

Different superscript letters identify statistical significance among columns of the chi-square test for linear association (a≠b≠c); (p<0.05).

should be revised, including all kinds of screen time-based technologies available to adolescents.

Our study found that girls were 39% less likely to be in both >2 to ≤4 hours and >4 hours/day of screen time. There is no consensus regarding the association of sex and the screen time. Some studies suggest that girls were less likely to engage in high screen time, either using with two hours/day² or using the 50th percentile of the sample distribution³ cut point. Other studies found that girls as a risk factor⁴ or did not find any relationship with high screen time.⁵ Despite this inconclusive relationship, there is evidence that girls are engaged in other types of sedentary behaviors, unlike screen time (television, video games, and computer), such as educational, cultural, and other extracurricular^{3,6,7,21} which might explain our results. Additionally, during adolescence, girls undergo body transformations and in proportions that can hinder motor and physiological performance, causing changes in behavior patterns. Another point is that girls were culturally encouraged to significant activities, to a greater engagement with daily tasks, housework, in addition to the transition from school to work, which may decrease time in physical activities.¹³

We also found that age was associated with screen time. Older adolescents were 71% (14 to 16 years old), and 89% (17 to 19 years old) less likely to >2 to ≤4 hours/day and >4 hours/day in screen time. However, the literature corroborates with our findings only for the older age group²² (17 to 19 years). Advancing age might favor the adolescents to engage in other activities besides screen time such as employment,^{23,24} an increase in their social and educational commitments,¹³ which may help explain their less engagement in screen time activities. Additionally, adolescents' screen time might have been replaced by other types of sedentary behaviors, such as smartphone use, which is a typical behavior adopted by adolescents nowadays.²⁵ Unfortunately, our study did not assess this behavior.

The findings of the present study should be interpreted with caution and are not without limitations. Screen time was estimated by a self-reported questionnaire that, although validated and widely used, tends to overestimate responses. Concerning regarding precision of estimates is a common issue of questionnaires; however, the ASAQ is recommended to measure sedentary behavior in adolescents.^{1,2} In order to minimize this bias, a highly

Table 2

Ordinal logistic regression and 95% confidence intervals for the association between sex, sexual maturation, age group, economic class, and nutritional status with the different cutoff points of screen time in adolescents. Greater Curitiba, Paraná Brazil. (N= 3,979)

	Unadjusted analysis						Adjusted analysis					
	O1 x O2+O3			O1+O2 x O3			O1 x O2+O3			O1+O2 x O3		
	OR	CI95%		OR	CI95%		OR	CI95%		OR	CI95%	
Sex												
Male	1	-	-	-	-	-	-	-	-	-	-	-
Female	0.64	0.52	0.79	-	-	-	0.61	0.49	0.76	-	-	-
Sexual maturation												
Pubescent	1	-	-	-	-	-	1	-	-	-	-	-
Prepubescent	4.35	1.18	13.73	-	-	-	1.94	0.68	5.54	-	-	-
Postpubescent	0.77	0.61	0.97	-	-	-	0.92	0.72	1.18	-	-	-
Age group (years)												
11 - 13	1	-	-	1	-	-	1	-	-	1	-	-
14 - 16	0.29	0.22	0.39	0.19	0.13	0.30	0.29	0.22	0.39	0.20	0.13	0.30
17 - 19	0.11	0.08	0.15	-	-	-	0.11	0.08	0.16	-	-	-
Economy												
Low	1	-	-	-	-	-	1	-	-	-	-	-
Intermediate	1.06	0.85	1.31	-	-	-	1.06	0.85	1.33	-	-	-
High	1.18	0.83	1.69	-	-	-	1.09	0.76	1.57	-	-	-
Body mass index												
Obese	1	-	-	-	-	-	1	-	-	-	-	-
Eutrophic	0.91	0.65	1.30	-	-	-	1.12	0.78	1.60	-	-	-
Low weight	1.66	0.75	3.66	-	-	-	1.42	0.64	3.13	-	-	-
Overweight	0.83	0.56	1.24	-	-	-	0.98	0.65	1.49	-	-	-

Adjusted analysis for all independent variables; OR = Odds ratio; CI95%= 95% confidence interval; O1 = Screen time ≤ 2 h/day; O2 = Screen time > 2 to ≤ 4 h/day; O3 = Screen time > 4 h/day; $p < 0.05$.

trained team assisted all respondents. Additionally, this study included only students from public schools, and the results should not be extrapolated to adolescents enrolled in private schools. However, a large sample processed through the careful sampling process in order to increase the internal validation of the study. The equally representative population of public-school students in Curitiba and São José dos Pinhais is a strong and significant point, which increases the external validity of the study.

The results indicate that, although adolescents are dedicating much of their time to sedentary activities, this behavior seems to differ between boys and girls, and between different age groups, which could result in changes in behavior patterns in different periods of adolescence. Future investigations should analyze other sedentary behaviors other than screen time such as smartphone use, educational and cultural activities, and future interventions should aim at reducing screen time throughout the day.

Sedentary behavior is associated with other health-related behaviors such as the intake of ultra-processed foods,¹ and low levels of physical activity.² It is a fact that boys and girls spend much of their daily time on screen time, clarifying the need for actions to reduce this behavior. Recommendations should not only focus on reducing screen time, but also in the adoption of a healthier lifestyle.

Authors' contribution

Piola TS carried out the study design, data collection, data analysis and interpretation, and manuscript preparation. Bacil EDA participated in data collection, data analysis and interpretation, and manuscript review. Pacífico AB and Campos JG participated in the elaboration of the manuscript. Silva MP participated in the study design, analysis and interpretation of data and approval of the final version of the manuscript. Campos W guided the research and participated in the approval of the final version of the manuscript.

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