Int J Public Health (2014) 59:77–86
DOI 10.1007/s00038-013-0464-3

SSPH+ SWISS SCHOOL OF PUBLIC HEALTH +

ORIGINAL ARTICLE

Changes in television viewing and computers/videogames use among high school students in Southern Brazil between 2001 and 2011

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Received: 12 November 2012 / Revised: 8 February 2013 / Accepted: 20 March 2013 / Published online: 4 April 2013
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Abstract
Objectives To compare the prevalence of television (TV) watching and of computer/videogame use among high school students (15–19 years) from Southern Brazil between 2001 and 2011 and to identify associated socio-demographic factors.
Methods Panel studies were conducted with high school students in the state of Santa Catarina, Brazil, in 2001 ($n = 5{,}028$) and 2011 ($n = 6{,}529$). TV watching and computer/videogame use were collected using questionnaires.
Results Prevalence of ≥2 h/day of TV watching dropped from 76.8 to 61.5 % and ≥2 h/day of computer/videogame use increased from 37.9 to 60.6 %. In both surveys, those aged 15–16 and those who did not work had higher likelihoods of being exposed to ≥2 h/day of TV watching. Boys, those with higher family income, and those who were living in urban areas had higher likelihoods of ≥2 h/day of computer/videogame use. Older age, studying at night and not working were protective factors to these behaviors.
Conclusions After a decade, there was a decrease in the prevalence of TV viewing and an increase in computer/videogame use. Socio-demographic factors were differently associated with these behaviors.

Keywords Sedentary lifestyle · Adolescents · Adolescent behavior · Cross-sectional studies · Trends

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Introduction

Accumulating evidence suggests that some screen-based behaviors (e.g., television (TV) viewing, recreational computer use, and videogame playing) are unfavorably associated with health indicators in school-aged youth, including less favorable body composition (Dumith et al. 2012), decreased fitness, lower self-esteem and pro-social behavior, and lower academic achievement (Salmon et al. 2011; Tremblay et al. 2011b). Because of these observations, some organizations, such as the American Academy of Pediatrics (2001) and the Canadian Society for Exercise Physiology (Tremblay et al. 2011a), recommend limiting the total media time of children and youths to no more than 2 h/day.

However, the data for recent changes in screen-based behaviors are limited and vary significantly between countries. For example, data from the "health behaviour in school-aged children" survey, from seven European countries, showed that the proportions of watching TV at least 4 h/day decreased between 1985/86 and 1997/98 in Norway, Scotland, and Wales, but the proportion increased in Hungary, Austria, and Finland (Samdal et al. 2007). In China, the proportion of at least 2 h/day of screen-based behaviors increased between 1997 and 2006, from 10 to ~40 % (Cui et al. 2011). Similar results were reported in Hong Kong, where the prevalence of TV or video watching for at least 2 h/day increased significantly between 1995 and 2000 among adolescents (Mak and Day 2010). Conversely, the US youth risk behavior surveillance surveys found a significant decrease in the prevalence of excessive TV watching between 1999 and 2007 (Lowry et al. 2009; Li et al. 2009) but noted an important increase in mid-adolescent computer use from 1999 to 2004 (Nelson et al. 2006).

Little is known about this subject in middle-income countries, which have undergone great technological transitions in the last few years, including Brazil. Therefore, it is important to investigate whether the prevalence of screen-based behaviors is changing in these countries and identify the socio-demographic characteristics associated with these behaviors. Thus, our purpose is to compare the prevalence of excessive time spent watching TV and/or using computers/videogames among high school students from Southern Brazil between 2001 and 2011 and to identify socio-demographic factors associated with these behaviors.

Methods

The participants of this study are part of a state-wide school-based epidemiological research panel study entitled "lifestyle and behaviors of risk of young people from Santa Catarina, Brazil—COMPAC project" carried out in 2001 and 2011. The population included public high school students between the ages of 15 and 19 years from Santa Catarina.

The sampling plan and methodological procedures employed in 2001 were maintained in the survey conducted in 2011. The following statistical parameter was used to calculate the sample size: unknown prevalence of the phenomenon, estimated at 50 % (due to numerous variables being studied). A confidence interval of 95 % was adopted, with a maximum error of two percentage points. These parameters yielded a minimum sample size of 2,373 students. Because the sample was by clusters, for the design effect, this amount was multiplied by two ($n = 4{,}746$), and another 25 % was added for the possible cases of losses or refusals during the collection, resulting in a final sample size of 5,932 adolescents. Detailed sampling procedures and additional information have been published elsewhere (Silva et al. 2013).

The geographical regions ($n = 6$) with their respective regional offices of education ($n = 26$) comprised the sampling strata. The selection of sample units occurred in two stages: (1) schools were stratified by size (large: $\geq$500 students, average: 200–499 students, and small: $<$200 students), and (2) specific classes were drawn by study shift (students attended school at morning/afternoon or at night shifts) and grade. Students between the ages of 15–19 from the classes selected and who were present in the classroom on the day the data were collected were eligible to participate in the survey.

In 2001, 216 schools were selected by systematic sampling, but five schools refused to participate, leaving 211 schools from the 598 available schools. In 2011, 90 schools were selected from the 725 available schools, with no refusals. To achieve 5,932 students, 240 classes were selected in the first survey and 344 in the second survey.

The research was conducted in the classroom. One or two trained test administrators had the instructions for completing the questionnaire by collective interview, adopting the manner used in the first survey, and using orientation by blocks in 2011. The administration of the questionnaire took 30–40 min in 2001 and 40–50 min in 2011. The data were collected from August to November in 2001 and from August to October in 2011.

The COMPAC (behavior of adolescents from Santa Catarina state) questionnaire was developed based on other international instruments for this population. It was tested for face and content validity; values of reproducibility ranging from 0.64 to 0.99 (De Bem 2003) were obtained in 2001 and 0.51–0.96 in 2011 (unpublished data).

The screen-time information was collected through two questions: "How many hours per day do you watch TV?" and "How many hours per day do you use the computer/videogames?" The questions were asked separately for school days (Monday–Friday) and for the weekend. In 2001, the responses were open; in 2011, there were five answer choices (none; $\leq$1, 2, 3, 4 or more h/day). The outcomes considered the weighted mean of TV watching or computer/videogame use, 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. The cutoff for TV watching, computer/videogame use, and total screen time was 2 h or more per day (American Academy of Pediatrics 2001; Tremblay et al. 2011a).

Demographic (i.e., gender, age and residence area), economic (i.e., students' employment and monthly family income), and school (i.e., grade and study shift) variables

were collected. The monthly family income was obtained by reporting the range of minimum wages (minimum wages: in 2001 = R$180.00 (transformation to dollars—US$, reference August, 2001 ($2.51): $71.71); and in 2011 = 545.00 (transformation to US$, reference August, 2011 ($1.60): $340.63) received by all members of the family who lived in the house. To minimize the distance in patterns of income attributed to changes in purchasing power over time, it was decided to use a tertile distribution to compare the relationship between income and the outcomes studied.

Absolute and relative frequencies were calculated to estimate the prevalence of the variables, which were compared using proportions of confidence intervals of 95 %. We then used crude and adjusted Poisson regression analyses. We adopted two-sided statistical tests with a significance level of 5 %. The analysis followed the hierarchical model of the variables in three levels (Dumith 2008). Socio-demographic variables (age and residence area) composed the first level, economic variables (students' employment and monthly family income) comprised the second level, and school variables (grade and study shift) made up the third level. In the adjustment model, we adopted a critical level of $p \leq 0.20$ for the remaining variables in the model to control for possible confounding (Maldonado and Greenland 1993). All analyses were stratified by gender and incorporated procedures for studies with complex methodologies (i.e., adding the prefix "svyset" to incorporate strata, conglomerates, and sample weight), with the use of available resources in STATA version 11 (Stata Corp., College Station, Texas, USA).

Both surveys were approved by the Ethics Committee on Human Research of the Federal University of Santa Catarina (process no.: 064/2000 and no: 1029/2010) and the Education Department of the State of Santa Catarina. All students (or their guardians for students under 18 years old) received a letter of consent and only participated in the survey if they agreed.

Results

In 2001, 5,463 students participated in this study, but 380 were excluded because they were outside of the age range. Another 55 subjects were lost due to incorrect completion of the questionnaire (response rate 92.1 %). Of the 5,028 students included, 95.4 % answered the question about watching TV and 68.4 % for computers/videogames use. In 2011, 7,077 students participated, excluding 508 and 40 questionnaires for the reasons cited above (response rate: 92.3 %). Of the 6,529 participants included, 99.7 % responded to the question on TV and 99.5 % about the use of computers/videogames.

In both surveys (2001 and 2011), there was a higher proportion of female students (59.6 vs. 57.8 %) and those living in urban areas (82.4 vs. 80.4 %). In 2001, more students were aged 17–19 years old (53.0 %), and in 2011, more students were aged 15 and 16 years (60.7 %), with a decline in the proportion of those working (55.0 vs. 50.5 %). In 2001, there was a higher proportion of teenagers studying at night (53.8 %), while in 2011, it was greater during the day (74.0 %). In both surveys, there was a higher concentration of young people attending the second grade of high school (42.7 vs. 36.0 %).

The prevalence of watching TV ≥2 h/day declined from 76.8 % (95 % CI: 73.7; 79.8) to 61.5 % (95 % CI: 59.7; 63.3) over 10 years. In 2001, boys and girls had similar percentages; however, there was a larger decline in boys (24.1 %) than in girls (16.8 %) after 10 years. In addition, watching TV increased in girls, with a difference of ~5.5 % points (Fig. 1). However, using computers/videogames ≥2 h/day increased from 37.9 % (95 % CI: 34.8; 41.1) to 60.6 % (95 % CI: 57.1; 64.1). This occurred in both genders (boys 59.6 %, girls 60.7 %). The percentage difference between the genders remained stable over time, with boys reporting a greater frequency of use (~14.0 %) than the girls. Total screen time ≥2 h/day increased from 86.0 % (95 % CI: 84.0; 88.0) to 90.6 % (95 % CI: 89.6; 91.5). The percentage difference increased ~5.0 % in both genders (Fig. 1). Still, it is important to highlight that the proportion of total screen time using as cutoff ≥4 h/day increased in one-third between 2001 (45.2 %, 95 % CI: 42.2%; 48.2 %) and 2011 (60.1 %, 95 % CI: 57.7 %; 62.4 %).

For all demographic and economic variables, the proportion of students watching TV ≥2 h/day decreased significantly from 2001 to 2011, except for girls living in rural areas or from families in the lowest tertile of income (Table 1). In addition, there was significant increase between 2001 and 2011 in using the computers/videogames ≥2 h/day in the indicators studied, with a relative difference over 30 % compared to the first survey (Table 2).

In both surveys, the likelihood of TV viewing ≥2 h/day was higher in young people who did not work and was lower in girls 17–19 years of age and in those who studied at night. In 2011, there was a lower likelihood of watching TV ≥2 h/day in boys 17–19 years of age, those who were in the second year of high school, those studying at night, and also between girls who lived in urban areas, with higher income and attending the third year of high school (Table 3).

The likelihood of computers/videogames use for ≥2 h/day was higher among youths from families with higher family incomes and among boys living in urban areas in both surveys. In 2011, students aged 17–19 years and those who studied at evening used computers/videogames less,

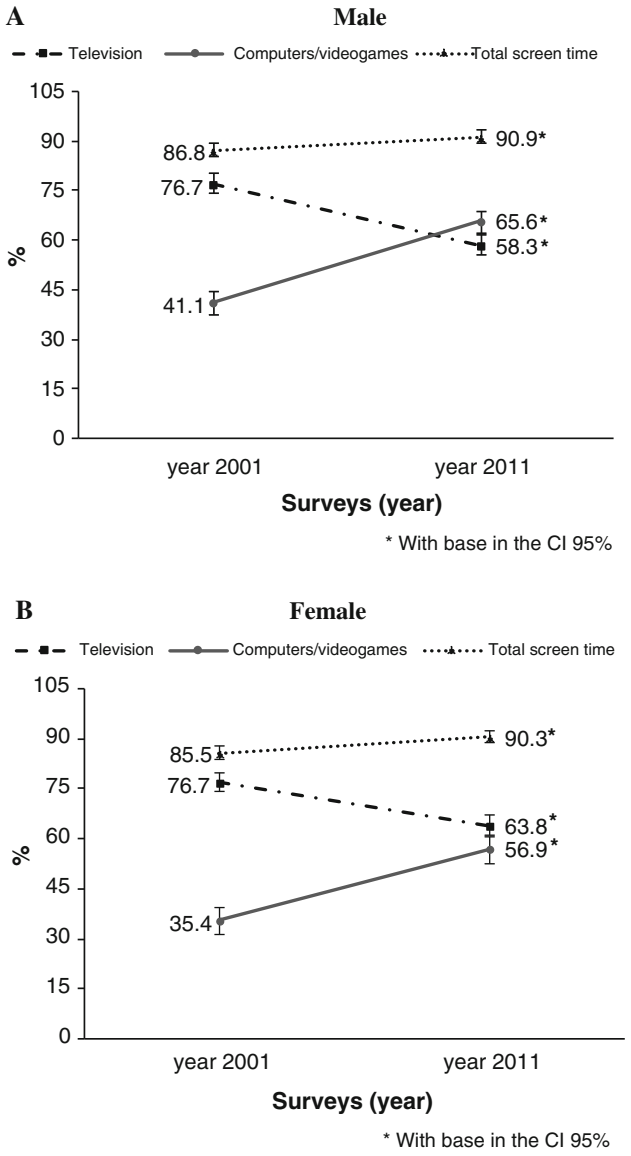

Fig. 1 Proportion of TV viewing, computers/videogames use and of total screen time ≥2 h/day in 2001 and 2011, by sex (**a** Male; **b** Female). Santa Catarina, Brazil

while those who did not work and girls living in urban areas used them more (Table 4). Finally, a larger number of socio-demographic factors associated with the screen-based sedentary behavior were shown in 2011 than in 2001.

Discussion

In the last decade, we observed a decline of 20 % in the prevalence of TV viewing ≥2 h/day and an increase of 60 % in the use of computers/videogames among students. Still, there was an increase in screen-based sedentary behavior of 5 % (≥2 h/day) and 33 % (≥4 h/day). However, little is known about the groups that are most susceptible to this transition. In other countries, computer use has increased (Edwards and Magel 2007; Nelson et al. 2006). Although TV watching has increased in some studies (Mak and Day 2010), it was stable in others (Edwards and Magel 2007; Nelson et al. 2006) or even decreased (Li et al. 2009; Lowry et al. 2009), as observed in this survey.

Between 1986 and 1998, the proportion of TV viewing ≥4 h/day declined in Norway, Scotland and Wales, increased in Austria and Finland among girls, and increased in Hungary in both genders (Samdal et al. 2007). In Spain, 38.4 % of adolescents watched TV, 15.1 % used computers and 4.0 % played videogames, all for 2 or more h/day (Serrano-Sanchez et al. 2011). In the WHO report of 2008, the prevalence of TV watching, computer and videogames use ≥2 h/day was 68.0, 42.0 and 31.0 %, respectively, in adolescents from 40 countries. In Brazil, recent studies have reported a prevalence of TV watching from 30.0 to 56.5 % among adolescents, depending on the cutoff used (Brazilian Institute of Geography and Statistics 2010a; Campagnolo et al. 2008; Fermino et al. 2010; Tenório et al. 2010). Similarly, computer/videogame use ≥2 h/day was 28.8 % in adolescents from 10 to 17 years old (Brazilian Institute of Geography and Statistics 2010a).

According to the National Household Survey (PNAD), between 2001 and 2009, an increase was noted in the proportion of the ownership of durable property existing in permanent private households. For example, TV ownership increased from 89.0 to 96.0 %, computer ownership increased from 12.6 to 35.1 %, and computer ownership increased with Internet access from 8.5 to 27.7 %. The data from the last census showed that the state of Santa Catarina (total number of permanent households surveyed) had a high coverage of access to TV (82.3 %) but less access to computers (41.4 %), primarily those connected to the internet (31.7 %) (Brazilian Institute of Geography and Statistics 2012). In addition, some government programs have added computers to the school environment. One program, PROINFO (National Program for Information Technology in School), began in 1997 to benefit access to technology by students from disadvantaged socioeconomic classes (Brazil Ministry of Education 1997). In the last school-based census of 2011, the data infrastructure of public schools showed that 91.8 % have a computer lab and 92.2 % have internet access, with indicators above 95.0 % in the south and southeast (National Institute for Educational Studies and Research 2012).

In Brazil, the culture of internet access has expanded to many public places, including coffee shops, gambling houses, and other shopping areas, at an affordable cost. This structure may facilitate an increase in computer use among youths. It is also important to note that the variety

Table 1 Changes in television viewing (≥2 h/day) according to socio-demographic variables, between 2001 and 2011, by sex (Santa Catarina, Brazil)

Variables	Male					Female				
	2001		2011		Δ (%)	2001		2011		Δ (%)
	n	%[a] (CI 95 %)	*n*	%[a] (CI 95 %)		*n*	%[a] (CI 95 %)	*n*	%[a] (CI 95 %)	
Age (years)										
15–16	890	78.2 (74.1; 82.4)	1,628	63.4 (61.0; 65.8)	**−18.9**	1,451	80.3 (76.1; 84.5)	2,202	66.3 (63.1; 69.5)	**−17.4**
17–19	1,064	75.6 (70.8; 80.5)	1,267	51.1 (47.8; 54.5)	**−32.4**	1,391	73.3 (69.0; 77.5)	1,411	59.7 (56.5; 62.9)	**−18.6**
Area										
Rural	449	77.5 (71.7; 83.3)	681	58.3 (53.2; 63.5)	**−24.8**	526	78.9 (72.5; 85.3)	849	68.4 (63.9; 72.9)	−13.3
Urban	1,489	76.6 (72.7; 80.5)	2,195	58.5 (56.0; 61.0)	**−23.6**	2,307	76.4 (72.9; 79.9)	2,737	62.8 (60.4; 65.2)	**−17.8**
Work										
Yes	1,227	71.3 (66.7; 76.0)	1,895	51.0 (47.4; 54.6)	**−28.5**	1,393	67.4 (63.3; 71.5)	1,747	53.9 (50.6; 57.3)	**−20.0**
No	708	85.4 (81.7; 89.2)	999	69.1 (64.3; 73.9)	**−19.1**	1,422	86.0 (82.5; 89.4)	1,864	71.6 (68.1; 75.1)	**−16.7**
Monthly family income										
1st tertile (lowest)	569	78.5 (73.1; 84.0)	716	56.5 (51.5; 61.4)	**−28.0**	1,036	76.1 (71.2; 80.0)	1,429	68.1 (64.6; 71.6)	−10.5
2nd tertile	729	76.8 (71.9; 81.7)	1,467	59.8 (56.7; 63.0)	**−22.1**	1,025	77.6 (73.2; 81.9)	1,693	62.8 (60.0; 65.6)	**−19.1**
3rd tertile (highest)	623	76.3 (71.3; 81.3)	687	57.0 (53.0; 61.0)	**−25.3**	730	76.8 (72.4; 81.1)	440	55.6 (49.8; 61.4)	**−27.6**
High school grade										
1st	647	76.5 (70.8; 82.3)	1,001	65.8 (62.3; 69.3)	**−14.0**	913	79.1 (75.1; 83.1)	1,018	70.7 (67.1; 74.4)	**−10.6**
2nd	774	78.7 (74.1; 83.4)	1,031	55.0 (51.5; 58.5)	**−30.1**	1,091	76.0 (70.1; 81.9)	1,304	64.4 (60.1; 68.7)	**−15.3**
3rd	521	73.8 (65.0; 82.6)	863	53.3 (49.5; 57.2)	**−27.8**	818	75.9 (69.9; 81.9)	1,291	57.4 (53.2; 61.7)	**−24.4**
Study shift										
Morning	768	80.7 (75.4; 86.0)	1,583	63.7 (61.1; 66.4)	**−21.1**	1,332	85.8 (81.1; 90.4)	2,352	67.3 (64.6; 70.1)	**−21.6**
At night	1,186	73.9 (69.3; 78.5)	1,312	45.9 (42.4; 49.4)	**−37.9**	1,510	67.8 (64.2; 71.5)	1,261	51.4 (46.5; 56.2)	**−24.2**

Bold: difference with $p \leq 0.05$

[a] Weighted data

of brands, models and sizes of computers manufactured in recent times contributes to lower prices, increases in lines of credit and purchasing power. The same applies to internet service providers. It seems to be a consensus that TV watching is the most prevalent screen-based sedentary behavior, but it has been stable or decreased over time. Although there was a trend toward increased computer use, the magnitude of this increase differs between sites and countries, due to cultural, social, and economic factors that are specific to each place.

In this study, a higher frequency of TV watching among young people who do not work may be related to a longer period of free time. Girls who were 17–19 years of age and those who studied at night watched less TV. It is possible that girls in that age group may have more chores and tasks of study, at work or at home, and may have had more autonomy to leave home than girls of 15–16 years. Regarding the study shift, perhaps the type of programming offered at night (novels and main newspapers) by the open TV channels encourages a greater interest on the part of the girls than do the other schedules. This would imply a restriction in those who study during this period.

Other Brazilian studies have also reported more TV watching in younger students compared to older students (Campagnolo et al. 2008; Tenório et al. 2010). Our findings are similar to those found in the state of Pernambuco, where workers and students who were studying at night were less likely to report TV viewing than their peers, and no difference was found between the school grades. However, the likelihood of TV watching on weekdays was lower among students from rural areas (Tenório et al. 2010). Other studies have found an association with the total money spent during the week (Leatherdale and Ahmed 2011) and school grade (Leatherdale and Ahmed 2011; Lowry et al. 2009).

Regarding the use of computers/videogames, patterns of income were determinants. This might be because of the costs necessary to purchase these devices, as well as the monthly expense for internet providers or additional costs for unlimited access to networks. This structure depends on the economic situation, which has more or less influence according to the index of development and income distribution in the country. In Brazil, from 2001 to 2009, the Gini index, an indicator that measures the distribution of

Table 2 Changes in computers/videogames use (≥2 h/day) according to socio-demographic variables, between 2001 and 2011, by sex (Santa Catarina, Brazil)

Variables	Male					Female				
	2001		2011		Δ (%)	2001		2011		Δ (%)
	n	%[a] (CI 95 %)	*n*	%[a] (CI 95 %)		*n*	%[a] (CI 95 %)	*n*	%[a] (CI 95 %)	
Age (years)										
15–16	711	44.6 (39.4; 49.9)	1,623	69.2 (65.1; 73.4)	**+55.2**	965	36.3 (31.5; 41.1)	2,198	59.3 (55.1; 63.6)	**+63.4**
17–19	819	38.2 (33.7; 42.7)	1,265	60.5 (56.7; 64.4)	**+58.4**	943	34.5 (29.5; 39.6)	1,412	52.8 (48.2; 57.4)	**+53.0**
Area										
Rural	291	29.9 (22.5; 37.3)	680	46.6 (41.7; 51.5)	**+55.9**	272	27.8 (17.6; 37.9)	848	38.3 (33.4; 43.2)	**+37.8**
Urban	1,227	43.3 (39.6; 46.9)	2,189	70.1 (66.8; 73.4)	**+61.9**	1.630	36.5 (32.4; 40.6)	2,735	61.7 (57.7; 65.7)	**+69.0**
Work										
Yes	973	38.7 (33.7; 43.8)	1,889	58.2 (54.9; 61.4)	**+50.4**	977	37.0 (32.5; 41.6)	1,745	53.7 (50.1; 57.3)	**+45.1**
No	544	45.2 (39.7; 50.7)	998	76.5 (71.3; 81.7)	**+69.2**	912	33.8 (28.0; 39.5)	1,863	59.4 (54.2; 64.5)	**+75.7**
Monthly family income										
1st tertile (lowest)	373	34.2 (26.9; 41.4)	713	49.3 (43.4; 55.2)	**+44.2**	577	25.8 (20.7; 30.9)	1,427	42.4 (36.8; 48.0)	**+64.3**
2nd tertile	589	37.3 (32.3; 42.3)	1,462	68.0 (64.8; 71.2)	**+82.3**	723	34.2 (28.6; 39.8)	1,691	63.5 (59.3; 67.7)	**+85.7**
3rd tertile (highest)	545	50.2 (45.1; 55.3)	688	75.3 (70.7; 80.0)	**+50.0**	587	45.9 (40.5; 51.3)	441	74.3 (69.2; 79.4)	**+61.9**
High school grade										
1st	488	41.9 (35.6; 48.1)	1,000	66.1 (60.8; 71.3)	**+57.8**	567	32.0 (26.9; 37.1)	1,016	56.8 (50.4; 63.3)	**+77.5**
2nd	615	39.6 (34.6; 44.5)	1,027	67.6 (62.8; 72.3)	**+70.7**	750	36.2 (30.1; 42.3)	1,301	58.6 (53.6; 63.5)	**+61.9**
3rd	422	43.0 (36.8; 49.3)	861	62.6 (57.9; 67.3)	**+45.6**	587	37.3 (28.9; 45.7)	1,293	55.2 (51.1; 59.3)	**+48.0**
Study shift										
Morning	626	44.7 (39.7; 49.8)	1,578	70.8 (66.7; 74.9)	**+58.4**	907	38.2 (32.1; 44.2)	2,351	59.8 (55.3; 64.2)	**+56.5**
At night	904	38.3 (33.9; 42.6)	1,310	53.9 (50.3; 57.5)	**+40.7**	1,001	32.8 (28.3; 37.2)	1,259	46.7 (43.2; 50.1)	**+42.4**

Bold: difference with $p \leq .05$

[a] Weighted data

the monthly average real income of people by occupation, showed a decline in income inequality (0.566–0.518) (Brazilian Institute of Geography and Statistics 2010b). Although family income may still be a factor associated with the use of computers/videogames, there was considerable growth in the lower income strata (1st tertile: 64.3 %, 2nd tertile: 85.7 %, 3rd tertile: 61.9 %) after a decade. However, the actual scenario indicates more TV watching among low-income youth and more use of computers/videogames among high-income youth.

The increased exposure to these behaviors among boys in urban areas may be explained by the difficulty of access to these devices in rural areas and by the existence of other forms of entertainment and daily routine tasks inherent to rural life.

Today, young people are more exposed to a diversity of media, such as TV, which has contributed to ambiguous health messages through qualifying and hindering the adoption of a healthy lifestyle. Scientific publications suggest that daily TV viewing ≥2 h is associated with reduced physical and psychosocial health (Tremblay et al. 2011b). Few reasons pointed are higher energy intake (Sisson et al. 2012) as well as the influence of the advertisements during TV programmes (Lobstein and Dibb 2005). Also, playing videogames have been independently associated with increased blood pressure and lipids in overweight adolescents (Goldfield et al. 2011). Thus, the excess of screen-based sedentary behavior represents a important public health issue, affecting direct and indirectly many potential risk factors for the development of diseases.

Some limitations were present in this study. Several methodological changes occurred between the surveys, such as adjusting the sampling plan, specifically the change in sample fractions in stages. For example, in 2001, the sampled schools represented 35 % of the total number of existing schools, and the sample of existing classes represented 11 % of the total of classes existing in the selected schools; in 2011, fractions of 12 and 29 %, respectively, were obtained by virtue of setting a criterion of equal size in the selection of classes. This procedure was adopted to enhance the data collection. In 2001, the response options

Table 3 Prevalence ratio of television viewing (≥2 h/day), according to socio-demographic variables, in 2001 and 2011, by sex (Santa Catarina, Brazil)

Variables	Male				Female			
	2001		2011		2001		2011	
	PR_c (CI 95 %)	PR_a (CI 95 %)	PR_c (CI 95 %)	PR_a (CI 95 %)	PR_c (CI 95 %)	PR_a (CI 95 %)	PR_c (CI 95 %)	PR_a (CI 95 %)
Age (years)								
15–16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
17–19	0.97 (0.90; 1.04)	0.97 (0.90; 1.04)	**0.81 (0.76; 0.86)**	**0.80 (0.75; 0.86)**	**0.91 (0.85; 0.98)**	**0.91 (0.85; 0.98)**	**0.90 (0.84; 0.96)**	**0.90 (0.84; 0.96)**
Area								
Rural	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Urban	0.99 (0.92; 1.07)	0.99 (0.92; 1.07)	1.00 (0.92; 1.09)	1.01 (0.93; 1.10)	0.97 (0.89; 1.05)	0.97 (0.89; 1.05)	**0.92 (0.86; 0.98)**	**0.92 (0.86; 0.98)**
Work								
Yes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No	**1.20 (1.12; 1.28)**	**1.20 (1.12; 1.28)**	**1.36 (1.21; 1.52)**	**1.32 (1.17; 1.49)**	**1.28 (1.20; 1.36)**	**1.26 (1.19; 1.34)**	**1.33 (1.23; 1.44)**	**1.30 (1.20; 1.41)**
Monthly family income								
1st tertile (lowest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2nd tertile	0.98 (0.90; 1.06)	0.99 (0.91; 1.07)	1.06 (0.96; 1.17)	1.08 (0.98; 1.18)	1.02 (0.96; 1.08)	1.01 (0.95; 1.08)	**0.92 (0.87; 0.98)**	0.94 (0.88; 1.01)
3rd tertile (highest)	0.97 (0.89; 1.06)	0.98 (0.90; 1.06)	1.01 (0.90; 1.13)	1.01 (0.91; 1.13)	1.01 (0.95; 1.07)	1.00 (0.95; 1.06)	**0.82 (0.72; 0.92)**	**0.84 (0.74; 0.95)**
High school grade								
1st	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2nd	1.03 (0.93; 1.13)	1.05 (0.95; 1.15)	**0.84 (0.77; 0.90)**	**0.88 (0.81; 0.95)**	0.96 (0.88; 1.05)	0.99 (0.92; 1.06)	**0.91 (0.84; 0.98)**	0.95 (0.88; 1.01)
3rd	0.96 (0.84; 1.11)	0.99 (0.87; 1.13)	**0.81 (0.75; 0.88)**	0.90 (0.80; 1.01)	0.96 (0.87; 1.05)	1.05 (0.95; 1.15)	**0.81 (0.74; 0.89)**	**0.84 (0.75; 0.95)**
Study shift								
Morning	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
At night	0.92 (0.84; 1.00)	0.96 (0.87; 1.05)	**0.72 (0.66; 0.78)**	**0.79 (0.72; 0.87)**	**0.79 (0.73; 0.86)**	**0.84 (0.77; 0.92)**	**0.76 (0.69; 0.84)**	**0.82 (0.75; 0.90)**

Weighted data. Bold: $p \leq .05$

PR_c crude prevalence ratio, PR_a prevalence ratio adjusted for levels: distal (age and area), intermediate (work and family income), and proximal (high school grade and study shift)

Table 4 Prevalence ratio of computers/videogames use (≥2 h/day), according to socio-demographic variables, in 2001 and 2011, by sex (Santa Catarina, Brazil)

Variables	Male				Female			
	2001		2011		2001		2011	
	PR_c (CI 95 %)	PR_a (CI 95 %)	PR_c (CI 95 %)	PR_a (CI 95 %)	PR_c (CI 95 %)	PR_a (CI 95 %)	PR_c (CI 95 %)	PR_a (CI 95 %)
Age (years)								
15–16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
17–19	0.86 (0.73; 1.01)	0.85 (0.71; 1.00)	**0.87 (0.82; 0.93)**	**0.87 (0.82; 0.93)**	0.95 (0.81; 1.11)	0.95 (0.81; 1.11)	**0.89 (0.83; 0.95)**	**0.89 (0.84; 0.95)**
Area								
Rural	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Urban	**1.45 (1.10; 1.90)**	**1.45 (1.11; 1.89)**	**1.50 (1.36; 1.67)**	**1.51 (1.36; 1.68)**	1.31 (0.91; 1.89)	1.31 (0.91; 1.90)	**1.61 (1.42; 1.83)**	**1.61 (1.42; 1.82)**
Work								
Yes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No	1.17 (0.96; 1.42)	1.14 (0.95; 1.38)	**1.31 (1.22; 1.41)**	**1.29 (1.20; 1.39)**	0.91 (0.76; 1.10)	0.89 (0.75; 1.08)	**1.10 (1.03; 1.19)**	**1.12 (1.06; 1.19)**
Monthly family income								
1st tertile (lowest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2nd tertile	1.09 (0.86; 1.38)	1.05 (0.82; 1.34)	**1.38 (1.25; 1.53)**	**1.35 (1.23; 1.48)**	**1.33 (1.05; 1.68)**	**1.32 (1.05; 1.67)**	**1.50 (1.32; 1.70)**	**1.46 (1.29; 1.64)**
3rd tertile (highest)	**1.47 (1.14; 1.89)**	**1.39 (1.07; 1.80)**	**1.53 (1.34; 1.75)**	**1.48 (1.31; 1.68)**	**1.78 (1.43; 2.21)**	**1.76 (1.44; 2.15)**	**1.75 (1.48; 2.07)**	**1.69 (1.44; 1.98)**
High school grade								
1st	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2nd	0.94 (0.77; 1.16)	0.96 (0.79; 1.18)	1.02 (0.94; 1.11)	1.04 (0.97; 1.12)	1.13 (0.90; 1.42)	1.13 (0.90; 1.42)	1.03 (0.92; 1.16)	0.99 (0.90; 1.09)
3rd	1.03 (0.83; 1.26)	1.07 (0.82; 1.39)	0.95 (0.86; 1.04)	1.01 (0.92; 1.11)	1.17 (0.89; 1.53)	1.13 (0.86; 1.49)	0.97 (0.88; 1.07)	0.99 (0.88; 1.12)
Study shift								
Morning	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
At night	0.86 (0.73; 1.01)	0.92 (0.78; 1.08)	**0.76 (0.70; 0.82)**	**0.82 (0.76; 0.89)**	0.86 (0.70; 1.05)	0.90 (0.74; 1.11)	**0.78 (0.72; 0.85)**	**0.79 (0.73; 0.86)**

Weighted data. Bold: $p \leq .05$

PR_c crude prevalence ratio, PR_a prevalence ratio adjusted for levels: distal (age and area), intermediate (work and family income), and proximal (high school grade and study shift)

of the dependent variables were open, and the options were closed in 2011 to enable optical reading of the questionnaire. In addition, the computers/videogames use variables were measured together. It is possible that the prevalence of these behaviors differs depending on demographic and socioeconomic information. No information was collected from young people about what they were doing in front of the TV or computer (e.g., if they were playing, working, surfing the internet, watching a program or studying) and during what period (e.g., in leisure time, at school or at work) they were watching. In addition, the variable of family income was reported by students and ignored the variability between reported and objective information. Thus, this variable may reflect only an approximation of the exact amount.

However, unedited information is discussed with regard to changes in the prevalence of TV watching and computer/videogame use in two distinct generations of high school students from a state in southern Brazil. We explored patterns of association with demographic and socioeconomic factors over time. Such information enables the monitoring of screen-time changes over generations and supports strategies to reduce excessive sedentary behavior in young people's daily routines. Future studies could examine the contribution of contextual factors (e.g., environment, economy and local development) on these behaviors using multilevel analysis. This would facilitate the understanding of the integrated behavior (i.e., subject and environment) and connect possibilities, opportunities and constraints.

Conclusion

Over a decade, there was a decrease in the prevalence of TV watching and an increase in the use of computers/videogames. TV viewing was higher among youths who did not work and lowest among girls 17–19 years old and those studying at night. The use of computers/videogames was greater in students from families with higher incomes and boys living in urban areas. Moreover, more demographic and socioeconomic variables were associated with these outcomes in 2011, including age, residential area and school variables (grade and study shift). Monitoring these changes is important for understanding the type and length of exposure to sedentary behavior in the routine activity of young people. This can increase the effectiveness of strategic actions aimed at reducing these behaviors in adolescence.

Acknowledgments This project was supported by the Foundation for Research and Innovation in the State of Santa Catarina, Brazil, and the Brazilian National Research Council (CNPq). None of these organizations influenced the study planning or the decision to submit the manuscript for publication.

References

American Academy of Pediatrics (2001) American Academy of Pediatrics: children, adolescents, and television. Pediatrics 107(2):423–426

Brazil Ministry of Education (1997) Programa nacional de tecnologia educacional. Ministry of Education, Brasilia

Brazilian Institute of Geography and Statistics (2010a) Síntese de indicadores 2009. Brazilian Institute of Geography and Statistics, Rio de Janeiro

Brazilian Institute of Geography and Statistics (2010b) Um panorama da saúde no Brasil: acesso e utilização dos serviços, condições de saúde e fatores de risco e proteção à saúde 2008. Brazilian Institute of Geography and Statistics, Rio de Janeiro

Brazilian Institute of Geography and Statistics (2012) Resultados gerais da amostra do censo demográfico 2010. Brazilian Institute of Geography and Statistics, Rio de Janeiro

Campagnolo PD, Vitolo MR, Gama CM (2008) Factors associated with excessive television watching among adolescents. Rev Bras Med Esporte 14(3):197–200

Cui Z, Hardy LL, Dibley MJ, Bauman A (2011) Temporal trends and recent correlates in sedentary behaviours in Chinese children. Int J Behav Nutr Phys Act 8(1):93

De Bem MF (2003) Estilo de vida e comportamentos de risco de estudantes trabalhadores do ensino médio de Santa Catarina. Thesis, Federal University of Santa Catarina

Dumith SC (2008) Proposal of a theoretical model to physical activity adoption. Rev Bras Ativ Fis Saude 13(2):110–120

Dumith SC, Garcia LMT, da Silva KS, Menezes AMB, Hallal PC (2012) Predictors and health consequences of screen-time change during adolescence: 1993 Pelotas (Brazil) birth cohort study. J Adolesc Health 51(6 Suppl):S16–S21

Edwards JU, Magel R (2007) Use of the youth risk behavior survey to monitor trends for nutrition and physical activity in a Midwest city school district. J Sch Health 77(7):351–358

Fermino FC, Rech CR, Hino AA, Añez CR, Reis RS (2010) Atividade física e fatores associados em adolescentes do ensino médio de Curitiba, Brasil. Rev Saude Publica 44(6):986–995

Goldfield GS, Kenny GP, Hadjiyannakis S, Phillips P, Alberga AS, Saunders TJ, Tremblay MS, Malcolm J, Prud'homme D, Gougeon R (2011) Video game playing is independently associated with blood pressure and lipids in overweight and obese adolescents. PLoS ONE 6(11):e26643

Leatherdale ST, Ahmed R (2011) Screen-based sedentary behaviours among a nationally representative sample of youth: are Canadian kids couch potatoes? Chronic Dis Inj Can 31(4):141–146

Li S, Treuth MS, Wang Y (2009) How active are American adolescents and have they become less active? Obes Rev 11(12):847–862

Lobstein T, Dibb S (2005) Evidence of a possible link between obesogenic food advertising and child overweight. Obes Rev 6(3):203–208

Lowry R, Lee SM, Fulton JE, Kann L (2009) Healthy people 2010 objectives for physical activity, physical education, and television viewing among adolescents: national trends from the youth risk behavior surveillance system, 1999–2007. J Phys Act Health 6(Suppl 1):S36–S45

Mak KK, Day JR (2010) Secular trends of sports participation, sedentary activity and physical self-perceptions in Hong Kong adolescents, 1995–2000. Acta Paediatr 99(11):1731–1734

Maldonado G, Greenland S (1993) Simulation study of confounder-selection strategies. Am J Epidemiol 138(11):923–936

National Institute for Educational Studies and Research (2012) Censo da educação básica: 2011 resumo técnico. National Institute for Educational Studies and Research, Brasilia

Nelson MC, Neumark-Stzainer D, Hannan PJ, Sirard JR, Story M (2006) Longitudinal and secular trends in physical activity and sedentary behavior during adolescence. Pediatrics 118(6):e1627–e1634

Salmon J, Tremblay MS, Marshall SJ, Hume C (2011) Health risks, correlates, and interventions to reduce sedentary behavior in young people. Am J Prev Med 41(2):197–206

Samdal O, Tynjälä J, Roberts C, Sallis JF, Villberg J, Wold B (2007) Trends in vigorous physical activity and TV watching of adolescents from 1986 to 2002 in seven European countries. Eur J Public Health 17(3):242–248

Serrano-Sanchez JA, Martí-Trujillo S, Lera-Navarro A, Dorado-García C, González-Henríquez JJ, Sanchís-Moysi J (2011) Associations between screen time and physical activity among Spanish adolescents. PLoS ONE 6(9):e24453

Silva KS, Lopes AS, Hoelfelmann LP, Cabral LGA, De Bem MFA, Barros MVG, Nahas MV (2013) Health risk behaviors project (COMPAC) in youth of the Santa Catarina State, Brazil: ethics and methodological aspects. Braz J Kinanthrop Hum Perform 15(1):1–15

Sisson SB, Broyles ST, Robledo C, Boeckman L, Leyva M (2012) Television viewing and variations in energy intake in adults and children in the USA. Public Health Nutr 15(4):609–617

Tenório MC, Barros MV, Tassitano RM, Bezerra J, Tenório JM, Hallal PC (2010) Atividade física e comportamento sedentário em adolescentes estudantes do ensino médio. Rev Bras Epidemiol 13(1):105–117

Tremblay MS, LeBlanc AG, Janssen IJ, Kho ME, Hicks AH, Murumets KM, Colley RC, Duggan MD (2011a) Canadian sedentary behaviour guidelines for children and youth. Appl Physiol Nutr Metab 36(1):59–64

Tremblay MS, LeBlanc AG, Kho ME, Saunders TJ, Larouche R, Colley RC, Goldfield G, Gorber SC (2011b) Systematic review of sedentary behaviour and health indicators in school-aged children and youth. Int J Behav Nutr Phys Act 8(1):98