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Abstract

Purpose: To evaluate secular trends in recreational sedentary behavior among high school students in the United States between 2003 and 2015. **Design**: A series of cross-sectional assessments over a 12-year period. **Setting**: Data from the 2003 to 2015 Youth Risk Behavior Surveillance System (YRBSS) was used. **Subjects**: Samples of 10,978-14,894 adolescents, drawn every 2 years: 2003-2015. **Measures**: The evaluated recreational self-reported sedentary behaviors included TV hours and computer hours that are not school work. **Results**: For the entire sample, and using polynomial orthogonal coefficients via regression modeling, there was an upward linear trend for total sedentary behavior hours (β=0.03, p=0.001), a downward linear trend in TV watching (β=-0.06, p<0.001), and an upward linear trend in computer use (β=0.08, p<0.001) from 2003 to 2015. Similar linear trends (p<0.001) were observed across several subpopulations, including the groups by gender, race/ethnicity, and BMI. However, various subpopulations differed in TV watching, with Black or African American, and obese adolescents having the highest TV watching hours, respectively (e.g., 3.82 hrs/day vs. 3.13 hrs/day in 2015; Blacks vs. Whites; P<0.05). Various subpopulations also differed in computer use, with obese adolescents (4.26 hrs/day in 2015) having the highest computer use. **Conclusion**: There were significant changes from 2003 to 2015 in sedentary behavior patterns in the US adolescents' population. Total recreational sedentary behavior increased in this period. Specifically, TV viewing decreased while computer use increased. Continued monitoring of sedentary behavior trends is needed to better understand the changing behaviors of American adolescents and how they relate to changes in chronic disease risk.

Keywords: health; adolescents; TV viewing; computer use

Introduction

Sedentary behaviors (from the Latin sedere, "to sit") include sitting or reclining with low energy expenditure during commuting, in the workplace, as part of education, in one's domestic environment, and during leisure time.[1] The energy expenditure range for sedentary behaviors such as computer use, TV viewing, or sitting in an automobile is typically from 1.0 to 1.5 metabolic equivalents (METs).[2]

Sedentary behaviors seem to be strongly related to a range of health outcomes, [3-6] such as overweight/obesity [7-9], cardiovascular disease [10,11], cholesterol [4,12], type 2 diabetes [13,14] and metabolic syndrome.[15,16] Studies of the relationship between sedentary behaviors and obesity in adolescents are emerging, potentially due to the high and rapidly increasing prevalence of overweight/obesity in this age group in the United States and worldwide.[17] Studies have suggested that spending too much time in non-interrupted sedentary behavior can have a downward impact not just on obesity but also on various other health outcomes.[18,19] While some authors claimed that the adverse effects of sedentary behavior on health are independent of moderate-to-vigorous physical activity, others argue that sedentary behavior, sleep, and physical activity are co-dependent parts of a 24-hour time-use composition and that their associations with health therefore cannot be considered independent from one another.[20] Regardless of whether sedentary behavior is conceptualized as a stand-alone variable or as a part of the time-use composition, from a public health perspective it is important to closely monitor its trends in the population. The population levels of sedentary behavior are alarmingly high. A population-based study estimated that Americans aged six years and older spend around 55% of their waking time in sedentary pursuits.[21]

A comprehensive understanding of secular trends in sedentary behavior is necessary as public health educators, clinicians and professionals attempt to identify time changes in the distribution of this health-influencing factor over time. Data on time trends in sedentary behavior are needed to inform the development of evidence-based strategies and interventions to tackle its high levels and prevalence in the population. Such trends data are also needed to assess the population-level effects of previous and ongoing public health initiatives. Furthermore, international studies on time trends in sedentary behavior have shown between-country differences.[22-24] It is, therefore, important to analyze time trends for a specific country. There is also a need for establishing trends in sedentary behavior for different age groups, as they may not necessarily be the same.[25] Besides, it is crucial to periodically update the trends analyses, to provide relevant insights into the most recent available data.

Growing trends of sedentary behavior have been found among adults in the US.[22] The overall time spent in sedentary behavior in this population group increased by more than 40% between 1965 and 2009. A recent study found a significant downward trend in TV viewing among American preschoolers (2-5 years old) between 2001 and 2012, while no such trend was observed among school children.[25] Several studies have examined time trends in sedentary behavior among in US adolescents up to 2010.[24,26-30] In this period, a gradual decrease over time has been observed for TV viewing among adolescents[24,26,27,30], while a growing trend was found for their computer use.[24,28,29] Evidence on more recent trends in sedentary behavior among US adolescents is scarce.

Adolescence is a period of an important transitional shift, where behaviors start to change.[31-33] This transitional turning point is also characterized by a high rate of obesity. [34] It was found that, in the US, adolescents are the most sedentary age group.[21] It is of particular importance to periodically evaluate temporal changes in sedentary behavior among this population group, because of its increased vulnerability to behavioral changes[35,36] and high susceptibility to engage in sedentary pursuits.[21] The main purpose of this study was, therefore, to evaluate potential secular trends in sedentary behavior among American high school students from 2003 to 2015.

Methods

Study Design and Participants

Data from the Youth Risk Behavior Surveillance System (YRBSS) were used for the present study. This cross-sectional survey employs national representative samples of students from grades 9-12 who attend public and private schools in the US, selected through multistage, cluster probability sampling. Details of the sampling strategy and psychometric properties of the 2015 YRBSS are reported elsewhere [37].

The methods of the national YRBSS survey have been approved by the CDC's institutional review board. Participation in the survey is entirely voluntary and anonymous, and the survey is conducted in accordance with local requirements for parental permission prior to data collection. To evaluate secular trends in sedentary behavior over time, participant data from the 2003-2015 YRBSS cycles were utilized. The overall 2003-2015 YRBSS analytic sample included 90,002 participants.

Recreational Sedentary Behavior

Recreational sedentary behavior was measured as a self-reported questionnaire measured only on weekdays not related to the sedentary behavior of the school. The outcome variables, TV hours and computer hours, were assessed using the following two questions in the YRBSS survey: (1) "On an average school day, how many hours do you watch TV?"; and (2) "On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work?". The response options included "I do not watch TV on an average school day / I do not play video or computer games or use a computer for something that is not school work"; "Less than 1 hour per day"; "1 hour per day"; "2 hours per day"; "3 hours per day"; "4 hours per day"; and "5 or more hours per day".

Body Mass Index (BMI)

Obesity status was assessed from BMI (kg/m^2) calculated based on self-reported weight and height. BMI was categorized into three levels: (1) 'obese' (i.e., BMI $\geq 95^{th}$ percentile by age and gender); (2) 'overweight' (i.e., 85^{th} percentile $\leq$ BMI $< 95^{th}$ percentile by age and gender); and (3) 'normal weight' (i.e., $5^{th} \leq$ BMI $< 85^{th}$ percentile by age and gender).

Statistical Analyses

All analyses, conducted in Stata® version 12 (StataCorp LLC, College Station, TX, USA), took into account the complex sampling design of the surveys. Mean values for the time spent watching TV and using computer (hours/day) were determined across the survey cycles. Case-wise deletion of missing data was applied. Tests for linear and quadratic trends were conducted

using orthogonal polynomial coefficients. Quadratic or second-degree polynomial curves are used to describe the so-called U-shaped or inverted U-shaped trends. A two-sided $p<0.05$ was considered to indicate a statistically significant trend.

Results

Table 1 shows the weighted demographic characteristics of the analyzed sample. Figure 1 and Table 2 displays the secular trends in the weighted mean total sedentary behavior hours across the evaluated YRBSS cycles from 2003 to 2015. For the overall sample, there was an upward linear trend ($p_{trend}=0.001$), with total sedentary behavior hours peaking in 2013 at 7.67 hrs/day (95% confidence interval [CI]: 7.49, 7.85). A similar upward linear trend was found in females. Their mean total time spent in sedentary behaviors increased to 7.60 hrs/day (95% confidence interval [CI]: 7.40, 7.81) in 2013. We did not find a significant trend among males. Regarding race-ethnicity, total sedentary behavior hours for White (7.26 hrs/day) and Hispanic/Latino (7.92 hrs/day) groups also peaked in 2013. Although for total sedentary behavior of Black or African Americans and other groups we did not find upward linear trends, Black or African Americans spent more time watching TV when compared to all other race-ethnicity groups. We also observed an upward linear trend across both obese and normal, in that the peak total sedentary behavior was higher in the obese group (8.41 hrs/day) than in the overweight (7.66 hrs/day) and normal weight (7.51 hrs/day) groups.

Figure 2 and Table 3 display the secular trends in the weighted mean TV watching hours for the overall sample and different population groups, respectively, across the evaluated YRBSS cycles from 2003 to 2015. For the overall sample, there was a significant, downward linear trend ($p_{trend}<0.001$). The mean time spent watching TV decreased from 4.08 hrs/day (95% confidence interval [CI]: 3.95, 4.20) in 2003 to 3.29 hrs/day (95% CI: 3.20, 3.38) in 2015. A similar downward linear trend was found in both males and females. From 2003 to 2015, the mean time spent watching TV decreased from 4.15 hrs/day (95% CI: 4.03, 4.27) to 3.29 hrs/day (95% CI: 3.17, 3.40) in male students and from 4.01 hrs/day (95% CI: 3.86, 4.15) to 3.29 hrs/day (95% CI: 3.18, 3.39) in female students. Regarding race/ethnicity, from 2003 to 2015, the amount of time spent watching TV decreased by 1.37, 0.92, 0.63, and 0.99 hrs/day for Black or African American, Hispanic/Latino, White, and other groups, respectively. In all study years, Black or African Americans spent more time watching TV when compared to all other race/ethnicity groups. The overall decline in the time spent watching TV over the study period was 0.93, 0.91, and 0.75 hrs/day for the obese, overweight, and 'normal weight' students, respectively. We also observed that in all study years TV watching was higher in students classified as obese than in the 'normal weight' group.

Figure 3 and Table 4 display secular trends in computer use across the evaluated YRBSS cycles for the overall sample and different population groups, respectively. There was a significant, upward linear trend ($p_{trend}<0.001$) in computer use in the overall sample and in all groups by gender, race/ethnicity, and BMI. The mean time spent using computers increased from 3.15 hrs/day (95% CI: 3.04, 3.26) in 2003 to 3.97 hrs/day (95% CI: 3.87, 4.07) in 2015. A similar upward linear trend was found in both males and females. From 2003 to 2015, the mean time spent using computers increased from 3.51 hrs/day (95% CI: 3.40, 3.61) to 3.99 hrs/day (95% CI: 3.89, 4.09) in male students and from 2.78 hrs/day (95% CI: 2.66, 2.90) to 3.94 hrs/day (95% CI:

3.82, 4.07) in female students. In all except the last two study years, male students reported significantly more computer use than female students. Regarding race/ethnicity, from 2003 to 2015, the amount of time spent using computers increased by 0.78, 1.13, 0.71, and 0.86 hrs/day for Black or African American, Hispanic/Latino, White, and other groups, respectively. The overall increase in the time spent using computer over the study period was 0.78, 0.76, and 0.83 hrs/day for the obese, overweight, and 'normal weight' students, respectively. We also found that in all study years computer use was higher in students classified as obese than in the 'normal weight' group.

Discussion

Our main findings are as follows. Self-reported TV watching among adolescents is still on the decline. Adolescents have reported progressively greater use of other screen-based behaviors (including computers, smartphones, and tablets) outside school hours (including gaming, texting, and social media). A linear increase in self-reported "other screen" use from 2003-2015 outpaced a linear decrease in TV watching during the same period. In total, adolescents reported nearly a half hour more of cumulative screen time in 2013-2015 than in 2003-2005.
Previous studies among US adolescents generally found temporal decline in TV viewing and increase in computer use.[24,26-30] The results of current study show that similar trends have continued after 2010. Our study findings regarding time trends also align with the results of other related studies internationally. According to a recent Czech study,[38] time spent watching TV did not change in boys, but girls showed a decrease in TV viewing in 1998-2000 cycle compared to 2008-2010 cycle. However, a study of Brazilian adolescents indicated a decreasing trend of TV watching in both boys and girls from 2001 to 2011.[39] In our study, we also observed a downward trend where TV watching hours in both genders decreased from 2003 to 2015. Furthermore, recent research has shown that the average TV watching hours for preschoolers, children, and adolescents in 30 countries slightly declined from 2001 to 2012, regardless of gender.[24,25,40] For computer use hours, in the present study, upward linear trends appeared in contrast to the trend for TV viewing hours. Such computer use trend in adolescents also aligns with secular trends observed in Europe, North and South America.[24]

Our results demonstrated that obese adolescents not only spent more time watching TV but also spent more time on the computer. TV viewing may promote the adoption of weight-compromising behaviors (e.g., snacking).[41] Further, TV viewing may encourage unhealthy food intake, such as fast food consumption, via fast food advertising shown while viewing.[42,43] Media use can also reduce physical activity opportunities by displacing time that could otherwise be spent being active.[44]

There are several limitations of our study. First, YRBSS data is based on self-report, which may be subject to recall and social desirability biases. However, YRBSS questions have generally been demonstrated to have good reliability and validity.[45-48] Due to the nature of the sedentary behavior questionnaire in YRBSS, it was not possible to examine screen times from other screens (e.g., phones, tablets, texting, social media, gaming and behavior that watch TV shows on computer), additional screen behaviors related to school work and to determine whether, for example, TV viewing occurred while in a 'motionless' scenario, as some individuals might have engaged in exercise (stationary cycling) while watching TV. It should also be noted that some

TV can be watched on computer screens, while some computer activities may be performed using TV screens. Therefore, TV time and computer use may not necessarily be distinct categories. Also, YRBSS questions are about "school days" so we could not identify screen time on the weekend. Lastly, another limitation is the potential limited sensitivity of the YRBSS screen assessments, as response options only included estimates in hour increments.

In conclusion, our analysis of the recreational sedentary behavior of the US high school students' population showed a linear increase in total sedentary behavior, a linear decrease in TV watching and a linear increase in computer use from 2003 to 2015. Notably, various subpopulations had different sedentary behavior estimates and patterns; Black or African American and obese students had the highest TV viewing, while male and obese students had the highest computer use. Continued surveillance of recreational sedentary behavior trends is needed to better understand the changing behavior of American high school students. In future studies, potential secular trends in non-gaming and gaming computer use among adolescents by gender, race, and BMI groups needs to be evaluated. Future research should evaluate secular trends in other sedentary behaviors.

So What?

What is already known on this topic?
Sedentary behavior is associated with numerous negative health outcomes.

What does this article add?
This study highlights secular trends in sedentary behavior across various Adolescent U.S. subpopulations.

What are the implications for health promotion practice or research?
This study highlights the importance of continued surveillance of sedentary behavior in this population and to evaluate whether these secular changes are associated with changes in chronic disease risk.

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Table 1. Weighted Demographic Characteristics Across the Evaluated Cycles (2003-2015 YRBSS; n=90,002)[a]

Characteristic	**2003 (n=12,020)**	**2005 (n=10,978)**	**2007 (n=12,807)**	**2009 (n=14,894)**	**2011 (n=13,635)**	**2013 (n=12,055)**	**2015 (n=13,613)**
Gender (%)							
Male	51.01 (49.27-52.74)	50.26 (49.10-51.42)	50.02 (48.72-51.33)	52.10 (49.48-54.72)	50.86 (49.03-52.68)	49.45 (48.19-50.71)	51.05 (47.97-54.33)
Female	48.99 (47.26-50.73)	49.74 (45.58-50.90)	49.98 (48.67-51.28)	47.90 (45.28-50.52)	49.14 (47.32-50.97)	50.55 (49.29-51.81)	48.95 (45.67-52.22)
Race/Ethnicity (%)							
Black or African American	13.21 (8.50-17.91)	12.28 (8.33-16.24)	14.71 (10.12-19.30)	13.84 (9.28-18.40)	13.21 (9.53-16.90)	13.47 (8.80-18.14)	12.87 (9.19-16.56)
Hispanic/Latino	17.08 (12.18-21.98)	14.75 (10.31-19.19)	16.17 (11.77-20.57)	18.21 (13.48-22.94)	19.25 (13.69-24.80)	20.63 (15.19-26.07)	21.80 (15.59-28.01)
White	61.68 (53.48-69.89)	65.39 (58.45-72.32)	61.38 (54.06-68.70)	59.71 (52.18-67.23)	58.71 (51.33-66.09)	57.14 (48.88-65.39)	55.84 (48.08-63.60)
Other	8.03 (6.07-9.99)	7.58 (5.54-9.61)	7.74 (5.61-9.86)	8.25 (5.23-11.26)	8.83 (6.81-10.84)	8.77 (6.79-10.74)	9.48 (7.32-11.64)
BMI (%)							
Obese	12.91 (11.66-14.17)	14.24 (13.32-15.17)	13.75 (12.42-15.08)	12.89 (11.77-14.01)	13.83 (12.42-15.24)	14.67 (13.34-16.01)	14.82 (13.18-16.47)
Overweight	16.64 (15.86-17.43)	16.91 (15.72-18.09)	17.32 (16.28-18.37)	16.98 (15.81-18.15)	16.56 (15.64-17.47)	18.08 (17.01-19.16)	17.83 (16.85-18.81)
Normal	70.45 (68.74-72.15)	68.85 (67.16-70.54)	68.93 (66.80-71.06)	70.13 (68.43-71.82)	69.61 (67.79-71.44)	67.24 (65.33-69.15)	67.34 (65.17-69.52)

[a]YRBSS = Youth risk Behavior Surveillance System
Values in parentheses indicate 95% CI

Table 2. Weighted Mean (95%CI) Hours of Total Sedentary Behavior per Day (2003-2015 YRBSS; N=90,002)[a]

Sample	2003 (n=12,020)	2005 (n=10,978)	2007 (n=12,807)	2009 (n=14,894)	2011 (n=13,635)	2013 (n=12,055)	2015 (n=13,613)	*p*-Trend$_{linear}$[b]	*p*-Trend$_{quadratic}$[c]
Overall Sample	7.23 (7.04-7.41)	7.01 (6.86-7.16)	7.18 (6.99-7.36)	7.06 (6.92-7.19)	7.35 (7.23-7.48)	7.67 (7.49-7.85)	7.26 (7.08-7.43)	0.001	0.503
Gender									
Male	7.66 (7.47-7.84)	7.52 (7.36-7.68)	7.55 (7.35-7.76)	7.32 (7.09-7.56)	7.61 (7.48-7.73)	7.74 (7.54-7.93)	7.28 (7.09-7.47)	0.169	0.948
Female	6.78 (6.58-6.99)	6.50 (6.32-6.68)	6.80 (6.61-6.99)	6.77 (6.63-6.91)	7.09 (6.93-7.25)	7.60 (7.40-7.81)	7.23 (7.03-7.43)	p < .001	0.185
Race/Ethnicity									
White	6.89 (6.69-7.09)	6.70 (6.55-6.85)	6.80 (6.62-6.98)	6.68 (6.55-6.81)	7.04 (6.92-7.17)	7.26 (7.03-7.49)	6.98 (6.73-7.22)	0.005	0.241
Black or African American	8.46 (8.29-8.62)	8.18 (7.99-8.37)	8.44 (8.28-8.61)	8.16 (8.01-8.31)	8.50 (8.15-8.84)	8.88 (8.64-9.11)	7.86 (7.58-7.13)	0.579	0.108
Hispanic/Latino	7.32 (7.09-7.55)	7.20 (7.03-7.37)	7.49 (7.23-7.75)	7.35 (7.19-7.51)	7.49 (7.31-7.66)	7.92 (7.71-8.12)	7.52 (7.37-7.68)	0.001	0.812
Other	7.58 (7.25-7.90)	7.42 (7.16-7.68)	7.11 (6.88-7.34)	7.28 (7.08-7.49)	7.42 (7.22-7.61)	7.90 (7.62-8.19)	7.45 (7.07-7.82)	0.356	0.133
BMI									
Obese	7.94 (7.72-8.16)	7.63 (7.45-7.81)	7.88 (7.68-8.08)	7.68 (7.50-7.85)	8.02 (7.82-8.21)	8.41 (8.18-8.63)	7.80 (7.62-7.97)	0.033	0.954
Overweight	7.33 (7.12-7.56)	7.21 (7.02-7.40)	7.42 (7.20-7.64)	7.23 (7.05-7.41)	7.36 (7.23-7.48)	7.66 (7.42-7.89)	7.19 (6.88-7.50)	0.598	0.582
Normal	7.07 (6.87-7.27)	6.83 (6.66-7.01)	6.97 (6.78-7.17)	6.90 (6.75-7.05)	7.22 (7.08-7.36)	7.51 (7.32-7.71)	7.15 (6.96-7.34)	0.001	0.316

[a]YRBSS = Youth Risk Behavior Surveillance System.
[b]Tests for linear trend were conducted using linear-specific orthogonal polynomial coefficients.
[c]Tests for quadratic trend were conducted using quadratic-specific orthogonal polynomial coefficients.

Table 3. Weighted Mean (95%CI) Hours of Watching TV per Day (2003-2015 YRBSS; n=90,002)[a]

Sample	2003 (n=12,020)	2005 (n=10,978)	2007 (n=12,807)	2009 (n=14,894)	2011 (n=13,635)	2013 (n=12,055)	2015 (n=13,613)	*p*-Trend$_{linear}$[b]	*p*-Trend$_{quadratic}$[c]
Overall Sample	4.08 (3.95-4.20)	3.96 (3.86-4.07)	3.88 (3.77-3.99)	3.76 (3.67-3.85)	3.73 (3.65-3.81)	3.66 (3.56-3.76)	3.29 (3.20-3.38)	p < 0.001	0.03
Gender									
Male	4.15 (4.03-4.27)	4.04 (3.94-4.14)	4.00 (3.88-4.12)	3.82 (3.70-3.94)	3.79 (3.72-3.86)	3.68 (3.57-3.79)	3.29 (3.17-3.40)	p < 0.001	0.01
Female	4.01 (3.86-4.15)	3.89 (3.76-4.01)	3.76 (3.65-3.88)	3.70 (3.60-3.80)	3.66 (3.57-3.76)	3.63 (3.52-3.74)	3.29 (3.18-3.39)	p < 0.001	0.23
Race/Ethnicity									
Black or African American	5.19 (5.06-5.33)	5.06 (4.97-5.16)	4.94 (4.84-5.05)	4.65 (4.56-4.74)	4.58 (4.37-4.80)	4.53 (4.39-4.67)	3.82 (3.66-3.97)	p < 0.001	0.002
Hispanic/Latino	4.34 (4.24-4.44)	4.25 (4.15-4.35)	4.17 (4.04-4.30)	4.06 (3.95-4.17)	3.88 (3.77-3.98)	3.82 (3.71-3.92)	3.42 (3.31-3.52)	p < 0.001	0.002
White	3.76 (3.66-3.85)	3.70 (3.61-3.78)	3.58 (3.49-3.66)	3.48 (3.41-3.55)	3.50 (3.43-3.58)	3.40 (3.29-3.51)	3.13 (3.01-3.25)	p < 0.001	0.13
Other	4.16 (3.99-4.33)	3.93 (3.77-4.09)	3.69 (3.48-3.89)	3.65 (3.49-3.81)	3.62 (3.50-3.73)	3.60 (3.42-3.78)	3.17 (2.96-3.38)	p < 0.001	0.94
BMI									
Obese	4.47 (4.32-4.61)	4.34 (4.20-4.48)	4.34 (4.23-4.46)	4.12 (4.00-4.24)	4.13 (4.01-4.25)	4.03 (3.90-4.15)	3.54 (3.42-3.65)	p < 0.001	0.001
Overweight	4.24 (4.08-4.39)	4.10 (3.98-4.22)	4.09 (3.95-4.23)	3.94 (3.82-4.05)	3.76 (3.67-3.84)	3.67 (3.53-3.81)	3.33 (3.18-3.49)	p < 0.001	0.02
Normal	3.97 (3.84-4.10)	3.85 (3.73-3.97)	3.74 (3.63-3.85)	3.65 (3.56-3.75)	3.64 (3.56-3.73)	3.57 (3.47-3.68)	3.22 (3.12-3.32)	p < 0.001	0.15

[a]YRBSS = Youth Risk Behavior Surveillance System.
[b]Tests for linear trend were conducted using linear-specific orthogonal polynomial coefficients.
[c]Tests for quadratic trend were conducted using quadratic-specific orthogonal polynomial coefficients.

Table 4. Weighted Mean (95%CI) Hours of Using Computer per Day (2003-2015 YRBSS; n=90,002)[a]

Sample	2003 (n=12,020)	2005 (n=10,978)	2007 (n=12,807)	2009 (n=14,894)	2011 (n=13,635)	2013 (n=12,055)	2015 (n=13,613)	*p*-Trend$_{linear}$[b]	*p*-Trend$_{quadratic}$[c]
Overall Sample	3.15 (3.04-3.26)	3.05 (2.97-3.13)	3.29 (3.19-3.40)	3.30 (3.22-3.38)	3.63 (3.56-3.69)	4.01 (3.91-4.12)	3.97 (3.87-4.07)	p < 0.001	0.001
Gender									
Male	3.51 (3.40-3.61)	3.48 (3.40-3.56)	3.55 (3.44-3.66)	3.51 (3.38-3.64)	3.82 (3.74-3.89)	4.06 (3.95-4.16)	3.99 (3.89-4.09)	p < 0.001	0.012
Female	2.78 (2.66-2.90)	2.61 (2.52-2.71)	3.04 (2.91-3.16)	3.06 (2.98-3.15)	3.43 (3.34-3.51)	3.97 (3.84-4.10)	3.94 (3.82-4.07)	p < 0.001	0.001
Race/Ethnicity									
Black or African American	3.26 (3.17-3.36)	3.12 (2.98-3.26)	3.50 (3.42-3.58)	3.51 (3.40-3.62)	3.91 (3.75-4.08)	4.35 (4.22-4.48)	4.04 (3.84-4.24)	p < 0.001	0.76
Hispanic/Latino	2.98 (2.82-3.13)	2.95 (2.83-3.07)	3.32 (3.17-3.48)	3.29 (3.19-3.39)	3.61 (3.50-3.71)	4.10 (3.97-4.22)	4.11 (4.01-4.20)	p < 0.001	0.009
White	3.14 (3.00-3.28)	3.01 (2.92-3.09)	3.22 (3.10-3.35)	3.20 (3.10-3.30)	3.54 (3.46-3.62)	3.86 (3.71-4.01)	3.85 (3.69-4.00)	p < 0.001	0.005
Other	3.42 (3.21-3.62)	3.49 (3.28-3.70)	3.42 (3.18-3.66)	3.63 (3.47-3.79)	3.80 (3.66-3.95)	4.30 (4.10-4.51)	4.28 (4.06-4.49)	p < 0.001	0.02
BMI									
Obese	3.48 (3.31-3.64)	3.29 (3.18-3.40)	3.54 (3.39-3.69)	3.56 (3.43-3.70)	3.89 (3.75-4.02)	4.38 (4.24-4.52)	4.26 (4.12-4.41)	p < 0.001	0.006
Overweight	3.10 (2.98-3.22)	3.11 (2.99-3.23)	3.33 (3.20-3.46)	3.29 (3.18-3.40)	3.60 (3.51-3.69)	3.99 (3.85-4.12)	3.86 (3.67-4.06)	p < 0.001	0.23
Normal	3.10 (2.98-3.22)	2.98 (2.90-3.07)	3.24 (3.12-3.35)	3.25 (3.16-3.33)	3.58 (3.51-3.65)	3.94 (3.82-4.06)	3.93 (3.82-4.04)	p < 0.001	0.002

[a]YRBSS = Youth Risk Behavior Surveillance System.
[b]Tests for linear trend were conducted using linear-specific orthogonal polynomial coefficients.
[c]Tests for quadratic trend were conducted using quadratic-specific orthogonal polynomial coefficients.

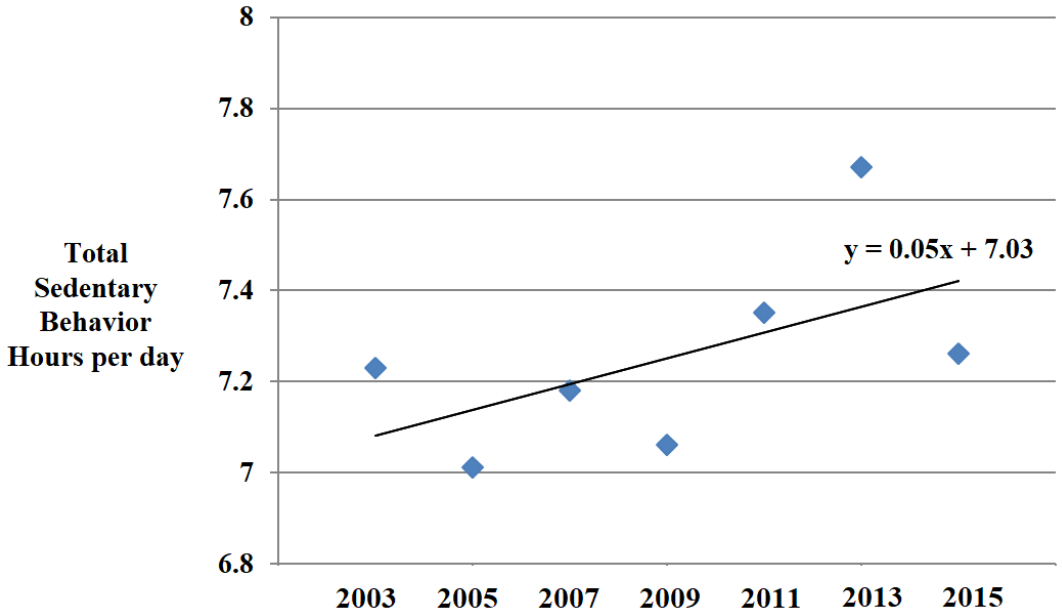

Figure 1. Weighted mean total sedentary behavior hours for the overall sample from 2003 to 2015 (n=90,002).

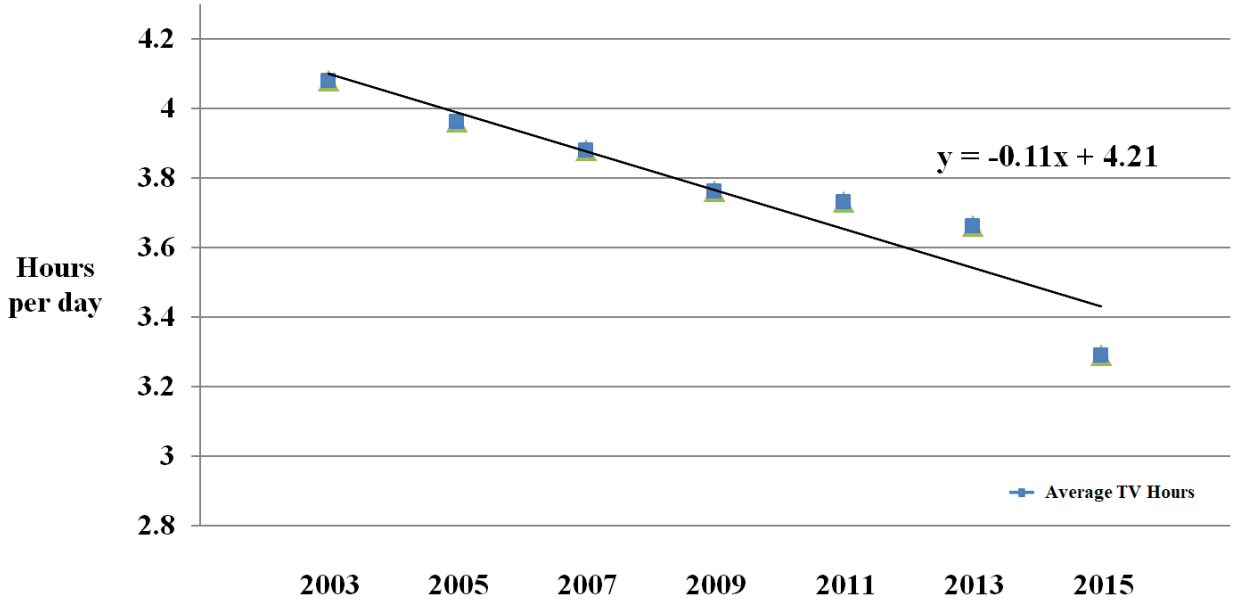

Figure 2. Weighted mean TV for the overall sample from 2003 to 2015 (n=90,002).

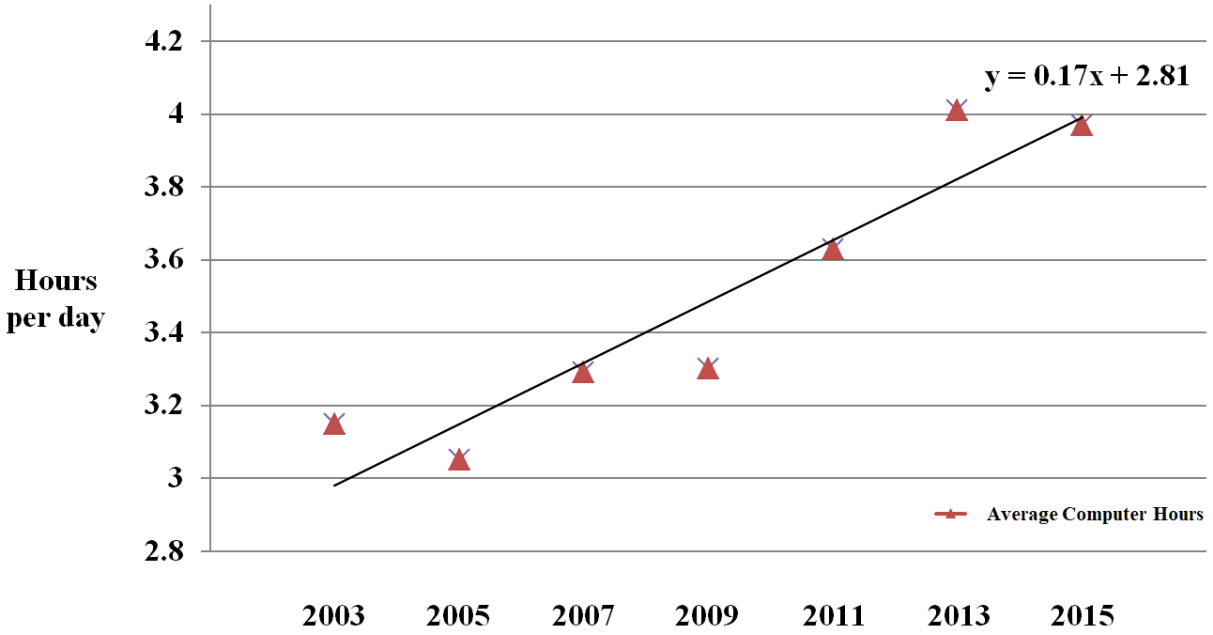

Figure 3. Weighted mean computer hours for the overall sample from 2003 to 2015 (n=90,002).