

# Food Consumption and Screen-Based Sedentary Behaviors in European Adolescents

## The HELENA Study

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**Objective:** To examine the association between time spent on different sedentary behaviors and consumption of certain food and beverage groups in a sample of European adolescents.

**Design:** Data from the Healthy Lifestyle in Europe by Nutrition in Adolescence Cross-sectional Study.

**Setting:** Eight survey centers (Athens, Dortmund, Ghent, Lille, Rome, Stockholm, Vienna, and Zaragoza).

**Participants:** A total of 2202 participants (45.5% boys) aged 12½ to 17½ years.

**Main Outcome Measures:** Information on sedentary behaviors (weekdays and weekends) collected via a standardized self-reported questionnaire, including watching television, playing computer and video games, using the Internet for studying or recreation, and studying. Food and beverage consumption data of selected groups were obtained using 2 nonconsecutive 24-hour recalls.

**Results:** Boys reporting more than 4 h/d of watching television, playing computer games, and using the Internet

for recreation were more likely to consume sweetened beverages (weekends) (odds ratio [OR], 1.83 [95% CI, 1.21-2.75]; 1.99 [1.31-3.01]; and 1.73 [1.03-2.91], respectively), and less likely to consume fruit (weekdays) (0.39 [0.21-0.72], 0.37 [0.18-0.77], and 0.39 [0.19-0.78], respectively) than those who spent less than 2 h/d. Girls spending more time per day watching television and playing computer or video games (weekdays) and playing computer games or surfing the Internet for recreation (weekends) were more likely to drink sweetened beverages (OR, 1.89 [95% CI, 1.21-2.94]; 1.57 [1.00-2.46]; 2.14 [1.16-3.97]; and 2.30 [1.24-4.28], respectively) and less likely to consume fruit (weekdays) (0.43 [0.23-0.80], 0.40 [0.19-0.83], 0.37 [0.14-0.94], and 0.42 [0.20-0.85], respectively) than those who spent less than 2 h/d.

**Conclusion:** Increased television viewing and computer and Internet use during adolescence is associated with higher odds of consumption of sweetened beverages and lower odds of fruit consumption.

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**D**ECREASING LEVELS OF PHYSICAL activity, unhealthy dietary habits, and the adoption of sedentary behaviors in children and adolescents are some of the main contributors to the increasing incidence of chronic diseases.<sup>1,2</sup> Sedentary behaviors act as independent risk factors of chronic diseases<sup>3,4</sup> and are defined as behaviors characterized by little physical movement and low energy expenditure (eg, sitting, watching television [TV], and using the computer and the Internet).<sup>5</sup> A recent review<sup>6</sup> suggested that sedentary behaviors can independently and differently influence food consumption and dietary intake depending on the type of activity—that is, the screen-viewing behavior found to be associated with

unhealthy food consumption.<sup>7,8</sup> In addition, engagement in sedentary behaviors has been associated with increased food consumption<sup>9,10</sup> and subsequently increased risk of obesity.<sup>11</sup> Television viewing is one of the most studied behaviors and is the dominant sedentary behavior during leisure time in adolescence.<sup>12</sup> It has been shown to coincide with excess energy intake,<sup>13</sup> increased meal frequency, and unhealthy eating patterns and food intake<sup>14,15</sup>—that is, consumption of energy-dense foods and beverages with lower nutritional value advertised on TV.<sup>16-18</sup> Increased TV viewing in adolescents has been associated with higher consumption of sweets,<sup>17,19</sup> savory snacks,<sup>13-15</sup> soda,<sup>15</sup> and soft drinks<sup>17,19</sup> and with lower consumption of fruit and vegetables.<sup>17,19</sup>

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A number of mechanisms have been proposed to explain the association between TV viewing and obesity including reduced time available for physical activity,<sup>20</sup> reduced resting metabolic rate,<sup>21</sup> and/or increased total energy intake.<sup>13,22</sup> Food and beverage advertisements on TV have been highlighted as having a powerful effect on the diet of young population groups.<sup>16</sup>

There are few studies examining the relationship using a comprehensive list of screen-time behaviors and the consumption of food and beverages. The aim of this study was to examine the association between time spent on different (mainly screen-based) sedentary behaviors and the consumption of specified food and beverages in a sample of European adolescents.

## METHODS

### STUDY DESIGN

The Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) Cross-sectional Study is a European Union-funded project on lifestyle and nutrition among adolescents from 10 European cities: Athens, Heraklion, Dortmund, Ghent, Lille, Pécs, Rome, Stockholm, Vienna, and Zaragoza.<sup>23</sup> The HELENA Cross-sectional Study inclusion criteria were age from 12½ to 17½ years, not participating simultaneously in another clinical trial, and free of any acute infection during the week before inclusion.<sup>24</sup> From October 1, 2006, through December 31, 2007, a total of 3528 adolescents (46.9% boys) aged 12½ to 17½ years were recruited. Participants from Heraklion (Greece) and Pécs (Hungary) (n=678) were not included in subsequent analyses owing to insufficient dietary intake data; there were too many adolescents who did not complete the second 24-hour recall (24HR). For the purposes of the current analysis, 2202 adolescents (45.5% boys) fulfilled the following inclusion criteria: to have completed at least 75% of the sedentary questionnaire (128 adolescents were excluded) and to have two 24HR available (1198 were excluded). Statistically significant differences in body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) and socioeconomic status (SES) ( $P < .001$ ) were observed between included and excluded adolescents (data not shown). A significantly higher proportion of excluded adolescents were included in the overweight/obese category (26.5% vs 21.1%) and in the lowest SES (20.0% vs 9.4%). Participants were recruited at schools. To guarantee that the heterogeneity of social background of the population would be represented, schools were randomly selected after stratification on school zone or district. Up to 3 classes from 2 grades were selected per school. All the adolescents within selected classrooms were invited to participate. Only adolescents from classrooms where more than 70% of the individuals consented to participate were included. Detailed operational study procedures are described elsewhere.<sup>23,24</sup>

The study was approved by the research ethics committees of each city involved. Written informed consent was obtained from the adolescents' parents and the adolescents themselves.<sup>25</sup>

### SOCIOECONOMIC STATUS

Collected demographic data included information on sex, age, and SES by means of a standardized self-reported questionnaire. A modified version of the Family Affluence Scale developed by Currie et al<sup>26</sup> was used as a proxy of SES status; the scale is based on the concept of material conditions in the family. The adolescents completed a questionnaire asking about the number of cars and computers at home, having access to Internet at home, and

whether the adolescent had his or her own room. For the purposes of the HELENA study, the Family Affluence Scale was slightly modified by replacing the item on frequency of family holidays by Internet availability at home. Adolescents were scored from 0 (very low SES) to 8 (very high SES). Subsequently, categories were merged into 3 groups: a score of 0 to 2 was grouped as low SES, 3 to 5 as medium SES, and 6 to 8 as high SES.

### ANTHROPOMETRIC MEASUREMENTS

The weight and height of the adolescents were measured by trained researchers in accordance with a standardized protocol.<sup>27</sup> Weight was recorded to the nearest 0.1 kg using an electronic scale (model 861; SECA), and height was recorded to the nearest 0.1 cm using a telescopic height-measuring instrument (model 225; SECA). Lightweight indoor clothing was worn, excluding shoes, long trousers, and sweaters. Body mass index and age- and sex-specific BMI z scores were calculated on the basis of standard definitions.<sup>28</sup> A physical examination was performed by a physician classifying the adolescents in 1 of the 5 stages of pubertal maturity defined by Tanner and Whitehouse.<sup>29</sup>

### SEDENTARY BEHAVIORS

A self-reported sedentary behavior questionnaire<sup>30</sup> was administered during school hours. Adolescents reported the frequency of specified sedentary behaviors using predefined response categories separately for weekdays and weekends. Behaviors assessed included watching TV, playing computer games, playing video games, surfing the Internet for recreation, surfing the Internet for study purposes, and studying (nonschool time). The predefined response categories were (1) none, (2) less than a half hour, (3) at least a half hour but less than 1 hour, (4) at least 1 but less than 2 hours, (5) at least 2 but less than 3 hours, (6) at least 3 but not more than 4 hours, (7) more than 4 hours. Participants were thereafter classified into 3 groups for each behavior (<2 h/d; 2-4 h/d; and >4 h/d). Grouping was based on the American Academy of Pediatrics' recommendations for media time.<sup>31</sup>

The reliability (1-week test-retest) of the questionnaire was studied in 183 adolescents (79 boys and 104 girls; age range, 12½ to 17½ years). For most variables, the Cohen  $\kappa$  values using quadratic weights showed a good agreement (>0.7).<sup>32</sup>

### DIETARY ASSESSMENT TOOL

Dietary consumption was assessed using the self-administered, computerized 24HR HELENA Dietary Assessment Tool based on the Young Adolescents' Nutrition Assessment software validated in European adolescents<sup>33</sup> ( $r_s = 0.86-0.91$ ) for all nutrient and energy intakes. The adolescents completed the 24HR twice (within 2 weeks) during school time; both times, trained staff including a dietitian were present. The HELENA Dietary Assessment Tool used special techniques to support and enhance respondents' memory, which allowed a more detailed description and quantification of the foods consumed.

The European Food Consumption Survey Method project indicated the repeated 24HR as the most suitable method to obtain population means and distributions.<sup>34</sup> Of the total 43 food groups, 8 were selected: (1) cakes, pies, and cookies; (2) savory snacks (ie, chips and crackers); (3) vegetables, excluding potatoes; (4) fruit; (5) fruit and vegetable juices; (6) sweetened beverages (carbonated, soft, and isotonic drinks); (7) milk; and (8) desserts and milk-based puddings. Selection of these food groups was based on their relationship to the health-related practices and to the prevalence of overweight and obesity.<sup>35</sup> Food and beverage consumption was expressed as grams and milliliters per day, respectively.

**Table 1. Sample Characteristics of 2202 Participants**

Variable	Boys (n = 1032)	Girls (n = 1170)	P Value <sup>a</sup>
Age, mean (95% CI), y	14.76 (14.68-14.83)	14.73 (14.66-14.80)	.57
Age categories, y, %			
12.50-13.99	31.1	32.9	.77
14.00-14.99	26.1	24.5	
15.00-15.99	22.9	22.9	
16.00-17.49	20.0	19.7	
Socioeconomic status, % <sup>b</sup>			
Low, 0-2	7.6	10.8	.03
Medium, 3-5	55.6	54.2	
High, 6-8	36.8	35.0	
Pubertal maturity, Tanner stage, %			
1-3	34.4	29.2	.04
4	41.0	44.6	
5	24.6	26.2	
Body mass index, mean (95% CI) <sup>c</sup>	21.28 (21.04-21.51)	21.19 (20.99-21.39)	.58
Optimal weight, %	76.0	81.3	.003
Overweight or obese, %	24.0	18.7	
Sedentary behaviors, mean (95% CI), min/d			
Television	110.27 (106.14-114.40)	108.76 (104.98-112.54)	.60
Computer	75.09 (70.50-79.68)	40.21 (36.85-43.56)	<.001
Video games	47.27 (43.38-51.15)	10.82 (9.19-12.45)	<.001
Internet	65.78 (61.48-70.08)	73.03 (68.87-77.19)	.02
Internet for study	25.18 (22.81-27.55)	29.07 (27.04-31.10)	.01
Study	61.23 (57.46-64.99)	77.83 (74.03-81.63)	<.001
Food group consumption			
Cakes, pies, and cookies, g/d			
Mean (95% CI)	57.80 (55.09-60.50)	51.39 (49.33-53.46)	<.001
Median (IQR)	46.8 (20.48-86.26)	44.6 (20.96-72.87)	
Savory snacks, g/d			
Mean (95% CI)	9.93 (8.80-11.05)	6.56 (5.86-7.25)	<.001
Median (IQR)	2.43 (1.56-4.53)	1.34 (0.71-3.16)	
Vegetables, g/d <sup>d</sup>			
Mean (95% CI)	88.32 (84.64-92.01)	91.45 (88.34-94.34)	.20
Median (IQR)	77.1 (42.33-120.23)	81.5 (51.95-121.49)	
Fruit, g/d			
Mean (95% CI)	125.05 (118.53-131.57)	128.85 (123.62-134.07)	.37
Median (IQR)	96.6 (39.52-176.74)	111.6 (53.83-182.73)	
Juices, mL/d <sup>e</sup>			
Mean (95% CI)	165.92 (155.65-176.19)	141.82 (134.10-149.54)	<.001
Median (IQR)	119.9 (39.76-239.50)	112.6 (35.76-208.95)	
Sweetened beverages, mL/d <sup>f</sup>			
Mean (95% CI)	376.37 (354.10-398.64)	215.09 (202.22-227.96)	<.001
Median (IQR)	279.3 (97.36-529.22)	140.1 (41.30-316.12)	
Milk, mL/d			
Mean (95% CI)	196.02 (183.67-208.37)	134.85 (126.05-142.34)	<.001
Median (IQR)	142.0 (40.65-281.37)	92.6 (25.48-199.31)	
Desserts and milk-based pudding, g/d			
Mean (95% CI)	10.60 (9.03-12.17)	13.48 (12.12-14.83)	<.05
Median (IQR)	1.4 (1.02-2.35)	2.3 (2.20-6.13)	

Abbreviation: IQR, interquartile range.

<sup>a</sup>Sex differences using Pearson  $\chi^2$  test for categorized variables and *t* test for continuous variables.

<sup>b</sup>Based on the Family Affluence Scale.

<sup>c</sup>Calculated as weight in kilograms divided by height in meters squared, with categories based on the cutoff values of Cole et al.<sup>28</sup>

<sup>d</sup>Vegetables exclude potatoes.

<sup>e</sup>Juices include fruit and vegetable juices.

<sup>f</sup>Beverages include carbonated, soft, and isotonic drinks.

### STATISTICAL ANALYSIS

Predictive Analytics software, version 18.0 (SPSS Inc), was used to analyze the data. All analyses were sex-specific because of observed significant differences in both sedentary behaviors and food and beverage consumption patterns. According to the nature of the studied variables, the  $\chi^2$  test and the unpaired *t* test were used to compare sample characteristics stratified by sex. Differences in food consumption according to time spent in each sedentary behavior was analyzed by 1-way analysis of covariance, adjusted for SES, Tanner stage, BMI, and country. The consumption of the predefined food and beverage groups was dichotomized on the basis of their medians. Binary logistic regression analyses were

performed to obtain odds ratios (ORs) and 95% CIs of food group consumption (above the median) by specified sedentary behaviors after adjusting for SES, Tanner stage, BMI, and center. The median cutoff selection was based on the lack of food group consumption recommendations for all countries. *P* ≤ .05 was considered to be statistically significant.

### RESULTS

**Table 1** presents descriptive information on mean age, SES, pubertal stage, mean BMI, time spent in each sedentary behavior (minutes per day), and food group con-

**Table 2. Analysis of Covariance of Food Group Consumption by Sedentary Behaviors Categories in 1032 Boys<sup>a</sup>**

Variable	Consumption, Mean (SE)							
	Cakes, Pies, Cookies, g/d	Savory Snacks, g/d	Vegetables, g/d <sup>b</sup>	Fruit, g/d	Juices, mL/d <sup>c</sup>	Sweetened Beverages, mL/d <sup>d</sup>	Milk, mL/d	Desserts and Milk-Based Pudding, g/d
TV weekdays, h								
<2	58.04 (1.55)	7.97 (0.67) <sup>e,f</sup>	90.63 (2.25)	132.91 (4.03) <sup>f</sup>	170.13 (6.34)	340.05 (12.61) <sup>e,f</sup>	199.37 (6.90)	10.66 (0.97)
2-4	57.18 (2.58)	13.00 (1.11) <sup>e</sup>	84.85 (3.74)	115.45 (6.71)	157.71 (10.56)	433.15 (20.98) <sup>e</sup>	193.87 (11.48)	10.02 (1.61)
>4	56.17 (5.63)	17.09 (2.43) <sup>f</sup>	81.39 (8.15)	93.68 (14.61) <sup>f</sup>	159.01 (22.98)	509.05 (45.68) <sup>f</sup>	161.54 (25.00)	11.95 (3.51)
TV weekends, h								
<2	60.26 (1.97)	7.99 (0.86) <sup>f</sup>	90.26 (2.87)	135.29 (5.13) <sup>f</sup>	166.28 (8.07)	340.10 (16.15) <sup>f</sup>	206.82 (8.79)	9.39 (1.23)
2-4	57.23 (2.05)	9.38 (0.89) <sup>g</sup>	91.17 (2.97)	123.40 (5.32)	172.04 (8.38)	375.40 (16.76) <sup>g</sup>	194.48 (9.11)	11.93 (1.28)
>4	51.80 (3.24)	15.38 (1.41) <sup>f,g</sup>	78.88 (4.71)	105.87 (8.44) <sup>f</sup>	153.97 (13.29)	452.99 (26.58) <sup>f,g</sup>	171.08 (14.46)	9.79 (2.02)
Computer weekdays, h								
<2	57.87 (1.43) <sup>f</sup>	9.12 (0.62)	89.38 (2.08)	129.28 (3.72) <sup>f</sup>	168.49 (5.83) <sup>f</sup>	350.74 (11.60) <sup>e,f</sup>	200.40 (6.37)	10.31 (0.89) <sup>f</sup>
2-4	58.38 (3.45)	10.39 (1.49)	85.78 (5.00)	121.31 (8.96)	168.13 (14.04)	433.02 (27.94) <sup>e,g</sup>	184.09 (15.33)	8.66 (2.14) <sup>g</sup>
>4	54.43 (6.39) <sup>f</sup>	17.38 (2.74) <sup>f,g</sup>	87.89 (9.27)	87.28 (16.59) <sup>f</sup>	100.96 (26.01) <sup>f</sup>	590.43 (51.75) <sup>f,g</sup>	152.64 (28.40)	21.45 (3.97) <sup>f,g</sup>
Computer weekends, h								
<2	58.49 (1.68)	8.71 (0.73) <sup>f</sup>	90.54 (2.39)	133.23 (4.38)	169.15 (6.87)	344.60 (13.58) <sup>f</sup>	204.89 (7.47)	10.80 (1.03)
2-4	57.29 (2.64)	8.95 (1.14) <sup>g</sup>	80.76 (3.76)	117.42 (6.89)	165.01 (10.80)	353.63 (21.40) <sup>g</sup>	185.05 (17.74)	7.83 (1.62)
>4	56.91 (3.43)	14.87 (1.48) <sup>f,g</sup>	93.38 (4.88)	116.68 (8.95)	156.91 (14.02)	514.37 (27.72) <sup>f,g</sup>	180.54 (15.24)	13.37 (2.10)
Video games weekdays, h								
<2	57.81 (1.36)	9.16 (0.59) <sup>f</sup>	89.75 (1.96)	128.97 (3.54)	167.14 (5.53)	355.39 (10.98) <sup>e,f</sup>	197.28 (6.02)	9.93 (0.78)
2-4	58.20 (5.32)	13.35 (2.32)	78.61 (7.71)	109.47 (13.89)	143.46 (21.71)	533.91 (43.11) <sup>e</sup>	187.04 (23.63)	14.67 (3.07)
>4	53.73 (8.05)	19.34 (3.50) <sup>f</sup>	76.54 (11.65)	91.31 (21.00)	183.36 (32.83)	641.79 (65.18) <sup>f</sup>	174.76 (35.72)	3.27 (4.65)
Video games weekends, h								
<2	58.17 (1.49)	8.82 (0.65) <sup>f</sup>	90.80 (2.16)	130.89 (3.89)	169.03 (6.09)	347.00 (12.14) <sup>e,f</sup>	198.94 (6.62)	9.93 (0.86)
2-4	47.81 (3.33)	10.05 (1.44) <sup>g</sup>	79.03 (4.82)	112.68 (8.67)	163.37 (13.56)	434.81 (27.07) <sup>e</sup>	189.08 (14.76)	11.62 (1.93)
>4	56.80 (4.76)	18.30 (2.06) <sup>f,g</sup>	89.64 (6.89)	111.55 (12.41)	143.64 (19.41)	523.48 (38.73) <sup>f</sup>	174.43 (21.13)	8.25 (2.75)
Internet weekdays, h <sup>h</sup>								
<2	57.84 (1.40)	9.25 (0.61) <sup>f</sup>	89.53 (2.03)	127.49 (3.61) <sup>f</sup>	166.13 (5.72)	358.29 (11.38) <sup>f</sup>	201.10 (6.21)	10.33 (0.87)
2-4	59.48 (4.11)	10.51 (1.79)	83.93 (5.95)	132.31 (10.62) <sup>g</sup>	168.14 (16.82)	419.69 (33.44) <sup>g</sup>	171.14 (18.27)	10.67 (2.55)
>4	52.62 (6.29)	17.75 (2.74) <sup>f</sup>	80.61 (9.10)	82.64 (16.24) <sup>f,g</sup>	156.35 (25.72)	593.55 (51.14) <sup>f,g</sup>	146.29 (27.94)	12.22 (3.91)
Internet weekends, h <sup>h</sup>								
<2	57.91 (1.52)	8.84 (0.66) <sup>f</sup>	90.40 (2.20)	128.42 (3.95)	167.03 (6.16)	344.29 (12.30) <sup>e,f</sup>	205.56 (6.73)	10.72 (0.95)
2-4	56.85 (3.06)	11.16 (1.33)	84.81 (4.44)	128.65 (7.97)	164.72 (12.45)	428.89 (24.85) <sup>e</sup>	174.07 (13.59)	7.88 (1.91)
>4	57.29 (4.63)	14.31 (2.01) <sup>f</sup>	84.33 (6.71)	104.05 (12.04)	155.80 (18.79)	518.51 (37.52) <sup>f</sup>	162.21 (20.52)	15.63 (2.89)
Internet for study weekdays, h								
<2	57.84 (1.31)	9.69 (0.57)	88.72 (1.90)	127.64 (3.43)	166.70 (5.37)	369.48 (10.74)	196.66 (5.85)	10.57 (0.82)
2-4	61.00 (8.25)	10.31 (3.60)	94.93 (11.93)	89.92 (21.54)	172.39 (33.73)	429.57 (67.44)	190.84 (36.74)	9.94 (5.16)
>4	45.57 (14.28)	5.48 (6.24)	49.34 (20.66)	121.52 (37.29)	117.19 (58.40)	366.26 (116.77)	114.90 (63.61)	18.12 (8.93)
Internet for study weekends, h								
<2	58.06 (1.32)	9.64 (0.58)	88.49 (1.91)	127.46 (3.45)	165.89 (5.40)	367.74 (10.80)	197.57 (5.86)	10.32 (0.82)
2-4	56.54 (7.39)	12.73 (3.23)	94.49 (10.69)	102.87 (19.31)	178.51 (30.20)	459.68 (60.48)	162.32 (32.80)	16.95 (4.61)
>4	34.46 (13.50)	10.88 (5.91)	66.35 (19.53)	99.41 (35.29)	167.96 (55.19)	467.05 (110.53)	133.92 (59.94)	19.09 (8.43)
Study weekdays, h								
<2	58.86 (1.39)	9.89 (0.61)	87.44 (2.02)	123.87 (3.60)	165.31 (5.68)	383.30 (11.31) <sup>e</sup>	194.03 (6.19)	10.80 (0.87)
2-4	52.21 (4.21)	8.38 (1.84)	97.13 (6.12)	138.34 (10.94)	184.04 (17.24)	282.43 (34.34) <sup>e</sup>	206.48 (18.81)	8.29 (2.64)
>4	44.82 (7.35)	9.00 (3.22)	95.25 (10.68)	153.47 (19.09)	149.88 (30.09)	294.06 (59.92)	225.60 (32.82)	12.53 (4.61)
Study weekends, h								
<2	58.96 (1.46)	9.85 (0.64)	87.10 (2.11) <sup>f</sup>	124.38 (3.78)	168.41 (5.95)	388.52 (11.89)	197.89 (6.49)	11.08 (0.91)
2-4	54.93 (3.28)	9.08 (1.44)	91.31 (4.76)	128.24 (8.52)	155.08 (13.43)	297.87 (26.84)	191.10 (14.66)	9.25 (2.06)
>4	45.15 (6.63)	11.09 (2.91)	110.91 (9.61) <sup>f</sup>	152.10 (17.21)	166.72 (27.12)	316.14 (54.20)	191.81 (29.60)	6.83 (4.15)

Abbreviation: TV, television.

<sup>a</sup>Covariates were socioeconomic status, Tanner stage, body mass index z score, and center.

<sup>b</sup>Vegetables exclude potatoes.

<sup>c</sup>Juices include fruit and vegetable juices.

<sup>d</sup>Sweetened beverages include carbonated, soft, and isotonic drinks.

<sup>e</sup>Significant differences between less than 2 hours and 2 to 4 hours ( $P < .05$ ).

<sup>f</sup>Significant differences between less than 2 hours and greater than 4 hours ( $P < .05$ ).

<sup>g</sup>Significant differences between 2 to 4 hours and greater than 4 hours ( $P < .05$ ).

<sup>h</sup>Internet use for recreation.

sumption (grams or milliliters per day). Sex differences were observed in SES and Tanner stage ( $P < .05$ ) and in all sedentary activities ( $P < .001$  or  $P < .05$ ), except for TV viewing ( $P > .60$ ). A high proportion of boys and girls (76.0% and 81.3%, respectively) were categorized into the optimal weight status (by BMI). Also, food group consumption differed by sex in all food groups ( $P < .05$ ), except for vegetables and fruits ( $P = .20$  and  $P = .37$ , respectively). In general, mean consumptions were higher for

boys than girls with the exception of fruit, vegetables, and desserts and milk-based puddings (which were higher in girls). **Table 2** and **Table 3** present the analysis of covariance results (means and SEs) for food group consumption by sedentary behavior categories for boys and girls, respectively. **Table 4** and **Table 5** present the results of the logistic regression analysis by sedentary behavior and food group consumption for boys and girls, respectively.

**Table 3. Analysis of Covariance of Food Group Consumption by Sedentary Behaviors Categories in 1170 Girls<sup>a</sup>**

Variable	Consumption, Mean (SE)							
	Cakes, Pies, Cookies, g/d	Savory Snacks, g/d	Vegetables, g/d <sup>b</sup>	Fruit, g/d	Juices, mL/d <sup>c</sup>	Sweetened Beverages, mL/d <sup>d</sup>	Milk, mL/d	Desserts and Milk-Based Pudding, g/d
TV weekdays, h								
<2	52.42 (1.26)	6.18 (0.43) <sup>e</sup>	94.35 (1.92)	135.88 (3.21) <sup>e,f</sup>	136.71 (4.70)	197.91 (7.53) <sup>e,f</sup>	135.10 (4.74)	12.91 (0.83)
2-4	48.83 (2.06)	6.75 (0.70) <sup>g</sup>	87.66 (3.14)	120.74 (5.25) <sup>f,g</sup>	151.10 (7.68)	239.04 (12.31) <sup>f,g</sup>	132.51 (7.74)	13.83 (1.36)
>4	53.91 (4.78)	11.31 (1.63) <sup>e,g</sup>	83.64 (7.31)	88.03 (12.21) <sup>e,g</sup>	159.24 (17.87)	323.80 (26.65) <sup>e,g</sup>	114.89 (18.01)	17.77 (3.16)
TV weekends, h								
<2	52.68 (1.60)	6.09 (0.54) <sup>e</sup>	96.98 (2.43) <sup>f</sup>	137.77 (4.07) <sup>e</sup>	142.42 (5.95)	196.45 (9.42) <sup>e</sup>	140.32 (5.99)	13.19 (1.06)
2-4	50.84 (1.63)	6.03 (0.55) <sup>g</sup>	87.34 (2.47) <sup>f</sup>	127.43 (4.14)	133.78 (6.06) <sup>g</sup>	215.16 (9.60) <sup>g</sup>	128.49 (6.09)	13.07 (1.08)
>4	49.92 (2.78)	9.69 (0.95) <sup>e,g</sup>	90.64 (4.23)	109.42 (7.08) <sup>e</sup>	163.64 (10.36) <sup>g</sup>	262.25 (16.40) <sup>e,g</sup>	126.47 (10.4)	15.13 (1.84)
Computer weekdays, h								
<2	51.62 (1.09)	6.44 (0.37)	93.05 (1.66)	131.20 (2.79)	141.04 (4.07)	208.46 (6.56) <sup>f</sup>	136.56 (4.08)	13.27 (0.72)
2-4	49.95 (4.12)	8.72 (1.41)	82.80 (6.29)	113.47 (10.57)	132.63 (15.38)	297.55 (2.48) <sup>f</sup>	103.66 (15.45)	13.01 (1.32)
>4	53.43 (7.76)	6.58 (2.66)	70.68 (11.86)	96.49 (19.90)	201.34 (28.98)	275.21 (46.75)	118.24 (29.09)	24.04 (5.13)
Computer weekends, h								
<2	52.26 (1.15)	6.31 (0.39)	92.53 (1.76)	1321.8 (2.94)	143.19 (4.29)	205.54 (6.93) <sup>f</sup>	137.16 (4.30)	13.08 (0.76) <sup>e</sup>
2-4	48.12 (3.01)	7.59 (1.03)	92.53 (4.60)	113.96 (7.71)	118.87 (11.23)	257.34 (18.17) <sup>f</sup>	126.46 (11.28)	11.93 (1.99) <sup>g</sup>
>4	49.15 (4.42)	8.28 (1.51)	82.24 (6.76)	111.75 (11.3)	163.18 (16.49)	270.41 (26.68)	102.94 (16.6)	21.60 (2.92) <sup>f,g</sup>
Video games weekdays, h								
<2	51.25 (1.04)	6.56 (0.36)	92.19 (1.60)	129.72 (2.68)	141.36 (3.91)	214.11 (6.33)	134.20 (3.93)	13.35 (0.69)
2-4	67.19 (9.88)	4.29 (3.38)	84.49 (15.17)	112.09 (25.45)	124.38 (37.05)	329.71 (60.01)	86.81 (37.29)	12.79 (6.56)
>4	30.78 (25.02)	0.66 (8.56)	63.56 (38.39)	64.32 (64.43)	151.30 (93.79)	229.71 (151.91)	166.83 (94.40)	27.52 (16.60)
Video games weekends, h								
<2	51.51 (1.06)	6.60 (0.36)	91.86 (1.63)	130.24 (2.73)	141.53 (3.98)	212.31 (6.44)	135.09 (3.99)	13.35 (0.70)
2-4	47.75 (5.70)	6.73 (1.94)	96.65 (8.71)	120.63 (14.63)	135.02 (21.29)	278.87 (34.49)	115.83 (21.40)	13.90 (3.77)
>4	64.55 (11.25)	3.15 (3.84)	86.11 (17.22)	97.99 (28.92)	157.99 (42.08)	288.33 (68.16)	89.05 (42.30)	16.88 (7.45)
Internet weekdays, h <sup>h</sup>								
<2	51.92 (1.15)	6.20 (0.40)	94.11 (1.76)	131.60 (2.95) <sup>e</sup>	143.01 (4.32)	204.68 (6.96) <sup>f</sup>	139.50 (4.34) <sup>f</sup>	12.89 (0.76)
2-4	50.71 (2.83)	8.17 (0.97)	84.55 (4.32)	127.29 (7.22)	130.89 (10.58)	259.22 (17.03) <sup>f</sup>	103.46 (10.61) <sup>f</sup>	14.04 (1.85)
>4	47.43 (5.05)	9.20 (1.73)	77.59 (7.70)	95.92 (12.89) <sup>e</sup>	147.81 (18.88)	278.68 (30.39)	116.70 (18.94)	18.99 (3.30)
Internet weekends, h <sup>h</sup>								
<2	52.53 (1.27)	5.77 (0.43) <sup>e,f</sup>	93.08 (1.93)	133.74 (3.25)	144.46 (4.74)	200.59 (7.63) <sup>e</sup>	142.30 (4.76) <sup>f</sup>	13.18 (0.84) <sup>e</sup>
2-4	49.23 (2.32)	8.03 (0.79) <sup>f</sup>	91.01 (3.53)	123.93 (5.94)	129.44 (8.67)	231.10 (13.95) <sup>f</sup>	116.31 (8.71) <sup>f</sup>	11.42 (1.53) <sup>g</sup>
>4	50.63 (3.25)	9.14 (1.11) <sup>e</sup>	84.04 (4.95)	113.42 (8.33)	147.14 (12.15)	284.64 (15.53) <sup>e,g</sup>	113.53 (12.20)	18.92 (2.14) <sup>e,g</sup>
Internet for study weekdays, h								
<2	51.21 (1.05)	6.55 (0.36)	91.58 (1.61)	130.08 (2.70)	140.73 (3.93)	215.37 (6.39)	133.59 (3.97)	13.34 (0.70)
2-4	64.24 (6.32)	6.79 (2.17)	106.98 (9.68)	127.71 (16.24)	164.33 (23.61)	200.30 (38.38)	143.82 (23.84)	13.52 (4.19)
>4	41.94 (17.73)	4.18 (6.08)	99.71 (27.16)	72.52 (45.57)	75.21 (66.25)	196.97 (107.68)	120.59 (68.89)	25.69 (11.75)
Internet for study weekends, h								
<2	51.45 (1.06)	6.57 (0.36)	91.99 (1.63)	130.12 (2.73)	141.61 (3.98)	215.00 (6.44)	133.35 (4.01)	13.07 (0.69)
2-4	52.40 (5.53)	7.01 (1.90)	91.93 (8.49)	130.54 (14.24)	141.92 (20.70)	226.76 (33.56)	132.94 (20.87)	17.03 (3.62)
>4	92.67 (17.71)	3.44 (6.09)	106.23 (27.20)	74.36 (45.64)	58.77 (66.36)	114.17 (107.56)	196.92 (66.88)	39.64 (11.61)
Study weekdays, h								
<2	50.74 (1.17)	6.55 (0.40)	90.78 (1.79)	126.65 (2.99) <sup>e</sup>	137.90 (4.37)	218.65 (7.10)	134.64 (4.43)	13.57 (0.78)
2-4	54.47 (2.77)	5.76 (0.95)	94.60 (4.24)	132.96 (7.07) <sup>g</sup>	153.27 (10.35)	195.23 (16.81)	127.66 (10.48)	12.58 (1.84)
>4	56.65 (5.11)	7.89 (1.75)	103.96 (7.83)	164.18 (13.05) <sup>e,g</sup>	169.60 (19.11)	216.31 (31.04)	146.70 (19.35)	11.75 (3.40)
Study weekends, h								
<2	50.73 (1.23)	6.90 (0.42)	90.39 (1.88)	125.10 (3.13) <sup>f</sup>	139.01 (4.61)	223.06 (7.44)	134.21 (4.65)	13.61 (0.81)
2-4	52.73 (2.28)	5.21 (0.78)	93.69 (3.47)	141.23 (5.80) <sup>f</sup>	144.82 (8.53)	188.28 (13.77)	134.46 (8.60)	12.00 (1.51)
>4	59.59 (4.61)	6.61 (1.58)	104.92 (7.04)	143.91 (11.76)	171.18 (17.30)	210.48 (27.92)	130.58 (17.43)	14.54 (3.05)

Abbreviation: TV, television.

<sup>a</sup>Covariates were socioeconomic status, Tanner stage, body mass index z score, and center.

<sup>b</sup>Vegetables exclude potatoes.

<sup>c</sup>Juices include fruit and vegetable juices.

<sup>d</sup>Sweetened beverages include carbonated, soft, and isotonic drinks.

<sup>e</sup>Significant differences between less than 2 hours and greater than 4 hours ( $P < .05$ ).

<sup>f</sup>Significant differences between less than 2 hours and 2 to 4 hours ( $P < .05$ ).

<sup>g</sup>Significant differences between 2 to 4 hours and greater than 4 hours ( $P < .05$ ).

<sup>h</sup>Internet use for recreation.

Boys who spent more time watching TV, using computers, playing video games, or using the Internet for recreation during weekdays and weekends were more likely to consume more savory snacks and sweetened beverages (Table 2). During weekdays and weekends, adolescents who watched TV more than 4 h/d were 1.96 (95% CI, 1.06-3.64) and 1.83 (1.21-2.75) times more likely

to drink sweetened beverages above the median amount, respectively (Table 4). In contrast, boys studying less than 2 h/d during weekdays and weekends were less likely to drink sweetened beverages than those who studied from 2 to 4 h/d (Table 2). The odds of drinking sweetened beverages decreased when the adolescents reported from 2 to 4 hours of study during weekdays (OR,

**Table 4. Binary Logistic Regression Analysis Predicting Food Group Consumption Above the Median Related to Sedentary Behaviors in Boys<sup>a</sup>**

Variable	Consumption Above the Median, OR (95% CI)							
	Cakes, Pies, Cookies	Savory Snacks	Vegetables <sup>b</sup>	Fruits	Juices <sup>c</sup>	Sweetened Beverages <sup>d</sup>	Milk	Desserts and Milk-Based Pudding
TV weekdays, h								
2-4	1.10 (0.80-1.52)	1.37 (1.01-1.86)	0.81 (0.60-1.10)	0.68 (0.51-0.92)	0.80 (0.59-1.08)	1.75 (1.27-2.42)	0.94 (0.68-1.29)	0.89 (0.64-1.23)
>4	0.85 (0.45-1.59)	1.64 (0.97-2.98)	0.63 (0.35-1.15)	0.39 (0.21-0.72)	0.72 (0.40-1.30)	1.96 (1.06-3.64)	0.83 (0.44-1.54)	0.89 (0.47-1.68)
TV weekends, h								
2-4	0.92 (0.68-1.24)	1.12 (0.84-1.50)	1.05 (0.79-1.41)	0.87 (0.66-1.16)	1.13 (0.84-1.50)	1.32 (0.98-1.79)	0.90 (0.66-1.22)	1.26 (0.93-1.71)
>4	0.80 (0.54-1.20)	1.49 (1.01-2.19)	0.76 (0.52-1.12)	0.49 (0.33-0.72)	0.75 (0.51-1.10)	1.83 (1.21-2.75)	0.70 (0.47-1.04)	0.93 (0.62-1.41)
Computer weekdays, h								
2-4	0.92 (0.62-1.37)	0.93 (0.64-1.36)	0.75 (0.51-1.10)	0.72 (0.50-1.04)	0.80 (0.55-1.16)	1.61 (1.08-2.40)	0.74 (0.50-1.10)	1.05 (0.70-1.57)
>4	0.80 (0.39-1.64)	0.92 (0.47-1.79)	0.87 (0.45-1.69)	0.37 (0.18-0.77)	0.38 (0.19-0.78)	2.03 (0.99-4.15)	0.80 (0.40-1.62)	1.36 (0.68-2.71)
Computer weekends, h								
2-4	0.96 (0.69-1.34)	1.17 (0.86-1.62)	0.75 (0.54-1.03)	0.72 (0.53-0.98)	0.98 (0.71-1.34)	1.09 (0.78-1.51)	1.02 (0.73-1.42)	0.90 (0.64-1.26)
>4	0.69 (0.46-1.04)	1.01 (0.68-1.48)	1.06 (0.72-1.55)	0.66 (0.46-0.97)	0.68 (0.46-0.99)	1.99 (1.31-3.01)	0.86 (0.58-1.28)	1.13 (0.75-1.70)
Video games weekdays, h								
2-4	1.00 (0.57-1.78)	1.23 (0.70-2.13)	0.63 (0.36-1.11)	0.45 (0.25-0.80)	0.69 (0.39-1.20)	1.75 (0.96-3.20)	0.93 (0.52-1.65)	1.21 (0.66-2.22)
>4	0.44 (0.17-1.11)	3.10 (1.24-7.75)	0.64 (0.28-1.50)	0.45 (0.19-1.05)	0.59 (0.26-1.36)	7.84 (2.55-24.10)	0.94 (0.40-2.22)	0.47 (0.19-1.18)
Video games weekends, h								
2-4	0.96 (0.66-1.41)	1.14 (0.79-1.65)	0.69 (0.48-1.01)	0.57 (0.40-0.83)	0.81 (0.56-1.18)	1.35 (0.91-1.99)	0.89 (0.60-1.30)	1.02 (0.69-1.52)
>4	0.79 (0.47-1.33)	1.84 (1.09-3.09)	1.07 (0.65-1.77)	0.61 (0.37-1.00)	0.70 (0.42-1.15)	3.04 (1.72-5.39)	0.85 (0.50-1.44)	0.91 (0.52-1.56)
Internet weekdays, h <sup>e</sup>								
2-4	1.26 (0.79-2.01)	1.05 (0.68-1.63)	0.71 (0.45-1.11)	1.09 (0.71-1.67)	1.34 (0.86-2.07)	1.24 (0.79-1.96)	0.71 (0.45-1.13)	0.78 (0.49-1.25)
>4	0.92 (0.46-1.83)	1.27 (0.66-2.44)	0.92 (0.48-1.77)	0.39 (0.19-0.78)	0.71 (0.37-1.36)	2.26 (1.11-4.60)	0.47 (0.23-0.97)	1.23 (0.62-2.42)
Internet weekends, h <sup>e</sup>								
2-4	1.03 (0.71-1.49)	1.20 (0.84-1.70)	0.80 (0.56-1.13)	0.97 (0.69-1.36)	0.95 (0.68-1.34)	1.58 (1.10-2.26)	0.69 (0.48-0.99)	0.88 (0.61-1.27)
>4	1.13 (0.67-1.89)	0.97 (0.59-1.59)	0.88 (0.54-1.44)	0.59 (0.36-0.97)	0.88 (0.54-1.43)	1.73 (1.03-2.91)	0.60 (0.35-1.01)	1.18 (0.70-1.99)
Internet for study weekdays, h								
2-4	1.36 (0.63-2.98)	1.13 (0.53-2.41)	0.66 (0.31-1.44)	0.60 (0.28-1.28)	0.74 (0.35-1.55)	2.13 (0.94-4.85)	0.58 (0.26-1.30)	1.99 (0.88-4.55)
>4	0.46 (0.11-1.98)	0.87 (0.22-3.55)	0.88 (0.23-3.39)	0.31 (0.06-1.52)	0.51 (0.13-1.98)	1.60 (0.38-6.66)	0.60 (0.15-2.40)	0.99 (0.21-4.60)
Internet for study weekends, h								
2-4	0.92 (0.38-2.24)	1.54 (0.66-3.60)	0.88 (0.38-2.02)	0.50 (0.21-1.19)	0.99 (0.43-2.31)	1.67 (0.68-4.09)	0.84 (0.34-2.04)	0.98 (0.39-2.47)
>4	0.73 (1.16-3.41)	0.69 (0.15-3.15)	0.31 (0.06-1.63)	0.54 (0.12-2.37)	0.24 (0.05-1.24)	1.85 (0.43-8.04)	0.55 (0.12-2.48)	2.43 (0.46-12.88)
Study weekdays, h								
2-4	0.70 (0.44-1.12)	0.65 (0.41-1.03)	1.24 (0.78-1.95)	1.69 (1.07-2.66)	1.49 (0.94-2.34)	0.51 (0.31-0.84)	1.45 (0.90-2.34)	0.78 (0.48-1.28)
>4	0.42 (0.18-0.97)	0.74 (0.34-1.62)	1.42 (0.66-3.04)	1.18 (0.56-2.48)	0.97 (0.46-2.06)	0.65 (0.29-1.47)	1.28 (0.57-2.88)	1.01 (0.44-2.31)
Study weekends, h								
2-4	0.97 (0.66-1.41)	0.76 (0.53-1.10)	1.14 (0.79-1.64)	1.30 (0.90-1.87)	0.86 (0.60-1.24)	0.57 (0.38-0.84)	1.22 (0.83-1.78)	0.78 (0.52-1.15)
>4	0.50 (0.24-1.03)	0.78 (0.39-1.56)	2.45 (1.17-5.16)	1.44 (0.72-2.85)	0.84 (0.42-1.67)	0.66 (0.32-1.36)	0.87 (0.43-1.78)	0.71 (0.34-1.50)

Abbreviations: OR, odds ratio; TV, television.

<sup>a</sup>The first category (<2 hours) was the reference category. Covariates were socioeconomic status, Tanner stage, body mass index z score, and center.

<sup>b</sup>Vegetables exclude potatoes.

<sup>c</sup>Juices include fruit and vegetable juices.

<sup>d</sup>Sweetened beverages include carbonated, soft, and isotonic drinks.

<sup>e</sup>Internet use for recreation.

0.51 [95% CI, 0.31-0.84]) and weekends (0.57 [0.38-0.84]) (Table 4). In addition, boys spending more than 4 h/d watching TV during weekdays and weekends and playing computer games or using the Internet for recreation during weekdays, were less likely to consume fruits than those who spent less than 2 h/d (Table 2). The odds of consuming fruit decreased with increasing time spent watching TV, playing computer or video games, or using the Internet for recreation. For instance, those who reported spending from 2 to 4 h/d playing video games were less likely to consume fruit during weekdays (OR, 0.45

[95% CI, 0.25-0.80]) and weekends (0.57 [0.40-0.83]) than those who reported spending less than 2 h/d. Also, the odds of consuming fruit increased with increasing study time (Table 4).

Girls spending more than 4 h/d watching TV or using the Internet for recreation were more likely to consume savory snacks and sweetened beverages than those who spent less than 2 h/d (Table 3). Girls who reported spending more time watching TV, playing computer or video games, or using the Internet for recreation had increased odds of drinking sweet-

**Table 5. Binary Logistic Regression Analysis Predicting Food Group Consumption Above the Median Related to Sedentary Behaviors in Girls<sup>a</sup>**

Variable	Consumption Above the Median, OR (95% CI)							
	Cakes, Pies, Cookies	Savory Snacks	Vegetables <sup>b</sup>	Fruits	Juices <sup>c</sup>	Sweetened Beverages <sup>d</sup>	Milk	Desserts and Milk-Based Pudding
TV weekdays, h								
2-4	1.08 (0.78-1.48)	0.86 (0.58-1.27)	0.81 (0.59-1.11)	0.68 (0.49-0.90)	0.80 (0.59-1.08)	1.83 (1.28-2.62)	0.91 (0.66-1.26)	0.97 (0.65-1.44)
>4	0.87 (0.47-1.63)	1.29 (0.58-2.91)	0.64 (0.35-1.18)	0.43 (0.23-0.80)	0.77 (0.43-1.37)	1.76 (0.90-3.45)	0.82 (0.44-1.54)	1.16 (0.54-2.50)
TV weekends, h								
2-4	0.87 (0.64-1.18)	0.94 (0.64-1.35)	1.09 (0.82-1.47)	0.77 (0.59-1.03)	1.00 (0.75-1.33)	1.35 (0.99-1.86)	0.92 (0.68-1.26)	1.36 (0.94-1.97)
>4	0.73 (0.49-1.09)	1.01 (0.61-1.68)	0.85 (0.58-1.26)	0.50 (0.34-0.74)	0.69 (0.47-1.01)	1.89 (1.21-2.94)	0.76 (0.51-1.14)	0.98 (0.57-1.67)
Computer weekdays, h								
2-4	0.93 (0.63-1.39)	1.01 (0.62-1.66)	0.77 (0.52-1.13)	0.69 (0.47-1.00)	0.83 (0.56-1.21)	1.28 (0.84-1.97)	0.74 (0.50-1.09)	0.84 (0.50-1.41)
>4	0.86 (0.42-1.75)	1.14 (0.47-2.74)	0.67 (0.33-1.34)	0.40 (0.19-0.83)	0.47 (0.24-0.92)	1.88 (0.82-4.31)	0.73 (0.37-1.47)	1.79 (0.84-1.41)
Computer weekends, h								
2-4	0.90 (0.65-1.26)	1.29 (0.85-1.97)	0.79 (0.58-1.01)	0.73 (0.53-0.99)	0.88 (0.64-1.21)	1.02 (0.72-1.44)	1.11 (0.79-1.57)	0.67 (0.43-1.05)
>4	0.71 (0.47-1.07)	1.06 (0.65-1.75)	1.06 (0.72-1.55)	0.69 (0.47-1.02)	0.70 (0.48-1.04)	1.57 (1.00-2.46)	0.84 (0.56-1.27)	1.11 (0.68-1.82)
Video games weekdays, h								
2-4	0.94 (0.53-1.66)	0.68 (0.35-1.34)	0.70 (0.39-1.25)	0.57 (0.32-1.01)	0.67 (0.39-1.17)	1.74 (0.88-3.44)	0.62 (0.35-1.11)	1.56 (0.80-3.05)
>4	0.50 (0.20-1.25)	1.82 (0.52-6.39)	0.54 (0.22-1.31)	0.37 (0.14-0.94)	0.69 (0.31-1.56)	7.26 (1.65-31.89)	0.62 (0.26-1.47)	0.23 (0.03-1.73)
Video games weekends, h								
2-4	0.90 (0.61-1.32)	0.89 (0.56-1.40)	0.79 (0.54-1.15)	0.61 (0.42-0.88)	0.77 (0.53-1.11)	1.35 (0.89-2.03)	1.04 (0.70-1.55)	1.32 (0.82-2.12)
>4	0.78 (0.46-1.31)	1.03 (0.53-1.99)	1.04 (0.63-1.73)	0.64 (0.38-1.06)	0.69 (0.42-1.14)	2.14 (1.16-3.97)	0.77 (0.45-1.30)	0.71 (0.32-1.54)
Internet weekdays, h <sup>e</sup>								
2-4	1.32 (0.83-2.12)	1.20 (0.66-2.19)	0.72 (0.46-1.13)	1.05 (0.68-1.61)	1.21 (0.78-1.87)	1.45 (0.86-2.43)	0.86 (0.54-1.37)	1.16 (0.67-2.00)
>4	0.98 (0.49-1.96)	1.07 (0.45-2.55)	0.82 (0.42-1.60)	0.42 (0.20-0.85)	0.91 (0.48-1.72)	2.38 (1.01-5.63)	0.57 (0.29-1.15)	1.13 (0.51-2.54)
Internet weekends, h <sup>e</sup>								
2-4	1.04 (0.72-1.50)	0.98 (0.63-1.51)	0.78 (0.55-1.11)	0.97 (0.69-1.36)	0.82 (0.58-1.15)	1.57 (1.07-2.32)	0.67 (0.46-0.97)	0.79 (0.49-1.28)
>4	1.13 (0.67-1.89)	0.97 (0.51-1.82)	0.86 (0.52-1.41)	0.65 (0.40-1.07)	0.95 (0.58-1.55)	2.30 (1.24-4.28)	0.69 (0.41-1.15)	1.57 (0.89-2.76)
Internet for study weekdays, h								
2-4	0.87 (0.36-2.13)	1.05 (0.36-3.00)	1.05 (0.45-2.44)	0.50 (0.20-1.23)	1.01 (0.43-2.34)	1.27 (0.50-3.23)	0.59 (0.24-1.42)	1.19 (0.39-3.62)
>4	0.69 (0.15-3.21)	NA	NA	0.63 (0.14-2.77)	0.39 (0.09-1.70)	0.74 (0.17-3.21)	1.03 (0.18-5.80)	1.99 (0.36-11.11)
Internet for study weekends, h								
2-4	1.28 (0.59-2.81)	0.95 (0.37-2.43)	0.78 (0.36-1.71)	0.53 (0.24-1.19)	0.73 (0.34-1.53)	1.44 (0.61-3.42)	0.52 (0.24-1.14)	1.57 (0.61-4.06)
>4	0.43 (0.10-1.86)	2.03 (0.23-17.75)	0.36 (0.07-1.78)	0.37 (0.08-1.81)	0.72 (0.19-2.76)	1.00 (0.25-4.08)	1.73 (0.33-9.00)	2.63 (0.48-14.48)
Study weekdays, h								
2-4	0.70 (0.44-1.12)	0.83 (0.48-1.42)	1.14 (0.72-1.79)	1.74 (1.11-2.73)	1.71 (1.08-2.72)	0.52 (0.33-0.84)	1.30 (0.78-2.17)	0.61 (0.31-1.21)
>4	0.47 (0.21-1.08)	1.47 (0.53-4.10)	1.67 (0.78-3.59)	1.23 (0.59-2.59)	1.64 (0.75-3.55)	0.60 (0.28-1.31)	1.59 (0.65-3.90)	1.07 (0.39-2.91)
Study weekends, h								
2-4	0.94 (0.64-1.37)	0.80 (0.51-1.25)	1.16 (0.80-1.67)	1.25 (0.87-1.79)	0.89 (0.62-1.29)	0.54 (0.37-0.79)	1.12 (0.75-1.66)	0.87 (0.53-1.42)
>4	0.53 (0.26-1.09)	1.33 (0.52-3.40)	2.53 (1.22-5.24)	1.52 (0.77-3.00)	1.24 (0.62-2.47)	0.52 (0.26-1.05)	1.17 (0.55-2.51)	0.58 (0.20-1.71)

Abbreviations: NA, not available (impossible to calculate the odds ratio [OR] [95% CI] because the group size is too small); TV, television.  
<sup>a</sup>The first category (<2 hours) was the reference category. Covariates were socioeconomic status, Tanner stage, body mass index z score, and center.  
<sup>b</sup>Vegetables exclude potatoes.  
<sup>c</sup>Juices include fruit and vegetable juices.  
<sup>d</sup>Sweetened beverages include carbonated, soft, and isotonic drinks.  
<sup>e</sup>Internet use for recreation.

ened beverages and decreased odds of consuming fruits (Tables 3 and 5). In contrast, girls who reported studying from 2 to 4 h/d during weekends were less likely to drink sweetened beverages than those spending less than 2 h/d (Table 5). The odds of consuming fruits decreased with increasing time spent watching TV, playing computer games, or using the Internet for recreation (Table 5).

**COMMENT**

To our knowledge, this is the first study to examine the relationship between sedentary activities and the consumption of food and beverages using a comprehensive list of sedentary activities in adolescents. The increased prevalence of electronic game playing (computer and

video games) and non-school-related computer access<sup>12</sup> promoted the examination of the effect of this medium on several lifestyles, including food consumption. Previous studies addressing similar associations have often focused on a single sedentary behavior, mainly TV viewing, and others have focused only on specific food groups—that is, only soft drinks<sup>36</sup> or fruits and vegetables.<sup>15</sup> Television viewing and Internet use were the predominant sedentary behaviors in this population of European adolescents. The study findings suggest that adolescents who spent more time in sedentary activities, mainly watching TV, playing computer games, and using the Internet for leisure time, had a higher consumption of sweetened beverages and savory snacks and a lower consumption of fruits.

Home environment and parental influence have an important effect on the development of health-related behaviors.<sup>37,38</sup> For instance, consumption of unhealthy foods is more frequent during afterschool time, and it is related to unsupervised food consumption at home and the availability of unhealthy snacks. As expected, adolescents spending a significant amount of time in sedentary behaviors and exceeding the 2-hour recommendation were more likely to consume more sweetened beverages. It is likely that individuals whose parents allow them to spend time in sedentary activities might also be those allowed to snack and drink sweetened beverages. Grim et al<sup>39</sup> also showed that, in children aged 8 to 13 years, watching TV 3½ hours or more per day was related to higher odds of consumption of soft drinks than watching less TV per day. Several studies in young age groups observed high TV viewing and computer use to be associated with an increased consumption of advertised foods (soft drinks and snacks).<sup>16</sup> Adolescents in this study who reported more TV viewing and computer and video game use were less likely to consume fruits, which agrees with the findings of other studies.<sup>16-18</sup> These trends could possibly result from the displacement of fruit by other frequently advertised foods. Screen viewing time activities, in particular TV viewing, have been associated with unhealthy eating practices<sup>8,40,41</sup> and may partly explain the relationship between sedentary behaviors and obesity.<sup>42</sup> During the past few years, sugar-sweetened beverage consumption emerged as the dietary factor most consistently associated with increasing weight status or fatness and subsequently with the obesity epidemic.<sup>37,43,44</sup> Parallel increases in the consumption of sweetened beverages and the prevalence of obesity suggest a causal relation between them.<sup>8</sup> This has resulted in the current recommendation of the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition to use water as the main source of fluids for children instead of sugar-sweetened beverages to avoid the development of obesity in children.<sup>45</sup>

It is possible that low levels of physical activity combined with cultural and/or parental attitudes toward watching TV, playing computer or video games, using the Internet for studying, and the availability of the Internet in the home might influence the amount of time adolescents spend in each sedentary behavior and their consumption of food. Identification of sedentary behaviors that increased the risk of obesity through its influ-

ence on energy balance is important in providing evidence of causality.

Several limitations of the present study should be addressed. First, no causal conclusions can be drawn because of the cross-sectional design of the study. Second, sedentary behaviors and food consumption data were based on self-reported questionnaires, and therefore a social bias must be considered. However, both questionnaires have been tested and validated, indicating acceptable accuracy.<sup>32,33</sup> Evaluation of the home environment as well as parental attitudes and practices have not been addressed in this study. Therefore, further studies are needed to assess their possible interactions with the observed findings. Generalizability of the findings is limited to the study population because the HELENA participants are not representative of the European population. Moreover, the differences between countries could be the result of different laws on advertising foods or special protection for children, among others.<sup>46</sup> For instance, Sweden controls the advertising of food to its young population, unlike other European countries.

Strengths of the study include a large and culturally diverse sample of European adolescents. The highly standardized procedures used within the HELENA study are also an important strength. In addition, the use of multiple 24-hour dietary recall interviews in estimating dietary behaviors combined with sedentary behaviors on weekdays and weekends is a relatively new approach because food frequency questionnaires were previously used.

In conclusion, excessive TV viewing and computer and Internet use during adolescence is associated with higher consumption of sweetened beverages and lower consumption of fruits. These adolescents could be at a greater risk of overweight and obesity and of poorer nutritional status. Efforts to promote healthy foods and to replace adolescents' sedentary time with alternative activities appear to offer a way forward in the short term. In addition, the role of the parents in creating a healthy eating environment should be considered in public strategies.

The increased consumption of sweetened beverages associated with video game and Internet use is a novel finding and essential in gaining a better insight into the determinants of obesity.<sup>47</sup> Given the fact that computer game playing is rapidly becoming the leisure-time activity of choice for a large group of children and adolescents, a better understanding of the influence that this activity has on dietary intake is important. This study adds evidence to support the American Academy of Pediatrics' recommendation for limiting media time to no more than 1 to 2 h/d for populations of this age.

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