

## Adolescents' Sedentary Behaviors in Two European Cities

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**Purpose:** The aim of this study was to determine and compare the correlates of objective sedentary behavior (SB) and nonschool self-reported SB in adolescents from 2 midsized cities, 1 in France (Tarbes) and 1 in Spain (Huesca). Stability of objective SB and nonschool self-reported SB were also assessed at different time points during 1 academic year. **Method:** Starting with a total of 829 participants and after applying inclusion criteria, objective SB was assessed for 646 adolescents ( $M_{\text{age}} = 14.30 \pm 0.71$  years) with GT3X accelerometers for 7 days at 2 time points. Nonschool self-reported SB was measured for 781 adolescents ( $M_{\text{age}} = 14.46 \pm 0.76$  years) at 3 time points by means of a questionnaire. Data were analyzed using multiple regression analysis. **Results:** Gender and ambient temperature emerged as the main statistically significant correlates in all objective SB models, showing higher objective SB levels in girls and lower objective SB levels when ambient temperature was higher. According to nonschool self-reported SB, a gender effect was found in almost all behaviors. Whereas boys spent more time playing with video games as well as games on their mobile phones, girls spent more time studying and using their computers and mobile phones to communicate with each other. The findings showed a statistically significant city effect on study time (Huesca > Tarbes) and video games and telephone communication time (Tarbes > Huesca). **Conclusion:** Nonschool self-reported SB patterns were different in Huesca and Tarbes. Intervention programs should be adapted to target the reduction of adolescents' SB according to different contexts.

**Keywords:** leisure time, media, screen time, sedentariness

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Submitted May 14, 2013; accepted January 22, 2015.

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Physical inactivity and its consequences have emerged as an important research focus in recent years. Physical inactivity has been associated with several noncommunicable diseases and it represents the fourth most common cause of mortality in the world. However, it should be noted that adolescents

can be both highly active and sedentary and that these are not necessarily opposites (Sisson, Broyles, Baker, & Katzmarzyk, 2011). Moreover, high levels of sedentary behavior (SB) per se may negatively influence adolescents' health (Sisson et al., 2011). Consequently, the goal of this study was to determine and compare the correlates of objective SB and nonschool self-reported SB in adolescents to improve the intervention programs aimed at reducing SB.

Defining SB is a complex task as it has changed over time (Pate, O'Neill, & Lobelo, 2008). For example, individuals have often been categorized as sedentary by default. They have been classified as sedentary if they do not meet physical activity guidelines or if they are inactive—not on the basis of measured participation in SB. By contrast, the improvement of assessment with an accelerometer permits a more precise definition of the activity limit intensity. A widely used strategy to classify behavior as sedentary is when these limits fall below a cutoff point of 100 counts per minute (cpm; Treuth et al., 2004). This corresponds to behavior that takes place during the waking day, such as sitting or lying down and expending very little energy.

Because objective SB is not merely the absence of physical activity (Pate et al., 2008), it is also likely that the correlates of objective SB will be different from those of physical activity, which have been studied by many researchers (Gorely, Marshall, & Biddle, 2004; King et al., 2011). To our knowledge, few studies (van Sluijs, Page, Ommundsen, & Griffin, 2010) have researched the levels and correlates of objective SB in adolescents by comparing European populations. It is therefore important to research SB and its correlates across different countries (Melkevik, Torsheim, Iannotti, & Wold, 2010) to design more efficient preventive actions (Trang et al., 2013).

It is not well known, either, how specific nonschool self-reported SB contributes to overall objective SB (Leatherdale, 2010). Because SB is multifaceted, a variety of these nonschool self-reported behaviors should be examined. The majority of previous research studies have only focused on television (TV) viewing time. However, during the last decade, other specific self-reported SB, such as computers, DVD/videos, and mobile phones have been assessed (Biddle, Pearson, Ross, & Braithwaite, 2010). Recent findings have shown how correlates between specific nonschool self-reported SB (TV viewing, computer use, or reading for pleasure) are different (Babey, Hastert, & Wolstein, 2013; Sisson et al., 2011). However, prior to designing interventions that might target reductions of specific nonschool self-reported SB, it is necessary to have a fuller understanding of the diverse patterns of these behaviors in adolescents (Biddle, Gorely, Marshall, & Cameron, 2009). In particular, SB based on the use of new technologies changes rapidly (Pate, Mitchell, Byun, & Dowda, 2011) and deserves special attention.

Pate et al. (2011) divided factors of influence on SB into five categories: demographic, biological, psychosocial,

behavioral, and environmental. This study has analyzed factors from three of these categories because of their convenience: demographic, biological, and environmental variables. Gender, city, age, and socioeconomic status (SES) have been analyzed from the demographic category, body mass index (BMI) has been analyzed from the biological category, and temperature and rainfall have been analyzed from the environmental variables group. These variables have been chosen to clarify their mixed associations with screen-based and non-screen-based SB (Pate et al., 2011). Other design-related variables, such as cohort and moment of data collection, have also been analyzed to control their possible influence.

Furthermore, according to Biddle et al. (2010), no studies have assessed the tracking of SB in European adolescents. Although one recent Norwegian study (Grebemariam et al., 2012) assessed the stability of some self-reported SB in the transition between childhood and adolescence, little is known about the stability of these behaviors in the global European population, especially in adolescents. Further research in this area is required.

The lifestyle patterns of young people are complex and involve numerous sedentary pursuits throughout the school day and weekend (Biddle et al., 2009), which are culturally distinct. That is why we used a cross-cultural design in this study. As noted by Beardsley and Pedersen (1997) noted, “findings from cross-cultural research are an important part of the epidemiological literature because they confirm and, in some cases, clarify confusing observations derived from specific populations” (p. 441). Cross-cultural comparisons of adolescent SB are interesting—not merely because they provide information about the range of activities in which young people engage in different contexts, but also because they make it possible to address the more fundamental sets of factors that might underline differences in SB levels between countries (West, Reeder, Milne, & Poulton, 2002).

Thus, the first aim of this study was to examine and compare some demographic, biological, and environmental correlates of nonschool self-reported and objectively measured SB among Spanish and French adolescents living in two midsized cities (Huesca in Spain and Tarbes in France). The second aim was to examine the stability of objective and nonschool self-reported SB across an academic year.

## METHODS

### Location

The Evaluation and Promotion of Adolescent Physical Activity (EPAPA) project selected two twin European cities, Huesca (in Spain, altitude 490 m, 52,443 inhabitants, 8,402 inhabitants/km<sup>2</sup>, regional gross domestic product: 23,094.9 Euros) and Tarbes (in France, altitude 304 m,

45,613 inhabitants, 2,975 inhabitants/km<sup>2</sup>, regional gross domestic product: 21,551.1 Euros), to conduct this study due to their geographical proximity (220 km apart, either side of the Pyrenees Mountains). Given that data were collected in two midsized cities, “Oscense” (collective demonym of Huesca) and “Tarbais” (collective demonym of Tarbes) will be used from now on to facilitate the reading of the article. In terms of climate, it should be noted that rainy weather is less usual in Huesca than in Tarbes (535 mm vs. 1,102 mm; average annual rainfall 1971–2000 [National Statistical Institute from Spain ([www.ine.es/](http://www.ine.es/)) and France ([www.insee.fr/fr/](http://www.insee.fr/fr/))]). However, univariate analyses of variance (ANOVAs) showed that the data related to the overall mean rainfall were exactly the opposite to what might have been expected (Huesca,  $2.87 \pm 5.37$  mm; Tarbes,  $1.92 \pm 3.09$  mm;  $p < .001$ ;  $\eta^2 = .012$ ). Ambient temperature was also higher in Huesca than in Tarbes ( $12.25 \pm 4.74^\circ \text{C}$  vs.  $11.49 \pm 6.35^\circ \text{C}$ ;  $p = .015$ ;  $\eta^2 = .005$ ) during the data collection period, although the difference was marginal ( $-0.76^\circ \text{C}$ ).

### Sample Design

The data collection for the EPAPA project took place for two cohorts of adolescents during the 2010–2011 and 2011–2012 academic years in 10 schools, 4 in Tarbes and 6 in Huesca. Participants in the 1st academic year were not the same as those who participated in the 2nd academic year. However, the participants did not vary within each cohort. Three waves of measurement were carried out within each cohort to collect questionnaire data (in October, February, and May). Collection of accelerometer data took place in all schools during two waves within each cohort, 5 months apart (Wave 1 from September to December and Wave 2 from February to May). Each wave had two consecutive measurement points, one for each city (e.g., September and October in Huesca, and November and December in Tarbes). All participants from each cohort year were measured in all accelerometer and questionnaire data collection periods. Data collection periods within waves were balanced between cities in the 2nd year of collection to control seasonal variation.

A total of 829 boys (44.8%) and girls (55.2%) from Tarbes (50.3%) and Huesca (49.7%) volunteered to take part in the whole project. Previously, participants and their parents were informed about the research project through information meetings at each school. Before participating in this study, parents provided written informed consent and adolescents gave written consent. The research project was approved by the appropriate ethics committees. Consent rates were 57% in Tarbes and 44.98% in Huesca. After eliminating cases with incomplete and missing data, according to inclusion criteria, the final sample consisted of 646 adolescents ( $M_{\text{age}} = 14.30 \pm 0.71$  years; 77.93% adherence to protocol). Possible differences, in terms of city,

gender, age, BMI, and SES, were analyzed for adolescents who volunteered to take part in the project but were excluded due to missing data or inclusion criteria (i.e., nonvalid group) and for the adolescents who formed part of the final sample (i.e., valid group). Gender differences (chi-square = 17.98,  $df = 1$ ,  $p < .001$ ; OR = 0.50 [0.36–.69]) were shown between the two groups (12.6% more boys in the nonvalid group). However, the effect size was small (OR = 0.50; Maher, Markey, & Ebert-May, 2013). It should be pointed out that there were no city differences between the nonvalid and the valid group.

### Measurements

#### *Biological, Demographic, and Environmental Data*

The participants self-reported age, gender, weight, and height. Regarding biological data, BMI was calculated from International Obesity Task Force cutoff points for children.

Regarding demographic variables, SES was measured with the Family Affluence Scale II (FAS-II; Currie et al., 2008). The FAS-II is a four-item valid international scale that asks students about how many “cars/bedrooms/computers” they have and how often they go on holiday. A composite FAS score was then calculated for each student summing up the responses to these four items. The sample was then categorized using a 3-point ordinal scale where low FAS (score = 0, 1, 2) indicates low affluence, medium FAS (score = 3, 4, 5) indicates medium affluence, and high FAS (score = 6, 7, 8, 9) indicates high affluence.

As far as environmental data are concerned, daily mean ambient temperature ( $^\circ\text{C}$ ) and rainfall (mm) data were collected from the National Meteorological Agencies in France and Spain ([www.france.meteofrance.com](http://www.france.meteofrance.com) and [www.aemet.es.com](http://www.aemet.es.com)) for each accelerometer recording day. Overall means of average daily ambient temperature and rainfall were calculated for each individual, according to the valid recorded days that made up the final dependent variables, after inclusion criteria had been applied. For example, if an individual had Monday, Wednesday, Friday, and Saturday as valid days, final mean ambient temperature and mean rainfall were calculated considering the values of those specific days.

#### *Objective Sedentary Behaviors and Outcome Measures*

The tri-axial GT3X accelerometer (Actigraph, Pensacola, FL) was used to continuously assess objective SB during waking hours during a 7-day period and for two time points during the academic year. The two measurement time points were separated by a minimum 5-month period. The GT3X accelerometer has been shown to be able to identify low levels of physical activity intensity, which, at 100 cpm, has been defined as sedentary (Treuth et al., 2004). The epoch was set at 15 s. Participants were provided with detailed

instructions on how to use the accelerometer (Trost, McIver, & Pate, 2005).

Before further processing, the following inclusion criteria had to be met: (a) The individual must have worn the monitor for at least 4 days, including 1 weekend day (Trost et al., 2005); and (b) a “full day of wearing” was defined as at least 10 hr of continuous monitoring per day on weekdays and at least 8 hr of continuous monitoring on each weekend day. Average daily wear time was  $789 \pm 89$  min and average daily nonwear time was  $650 \pm 89$  min. Average daily wear time was  $796 \pm 95$  min in Huesca and  $782 \pm 82$  min in Tarbes,  $F(1, 1,258) = 8.11$ ,  $p < .001$ ,  $\eta^2 = .006$ . Although in this case the  $p$  value may be meaningless because it may be biased by the large sample employed, we conducted statistical analyses with percentages of daily objective SB (e.g.,  $\sim 69\%$  of the total daily wear time) to make sure the final results were not biased. The time spent on sedentary activities (min/day) was calculated from the output obtained by using the standardized cutoff point (Pate et al., 2008) of 100 cpm. It should be noted that although this cutoff point has been shown to approximate low energy expenditure activities (Matthews et al., 2008), measuring objective SB via accelerometry does not discriminate between sitting and standing very still, so time recorded as sedentary does not strictly represent sitting time. However, this count threshold for objective SB has been broadly accepted in specific literature (Pate et al., 2008).

### Nonschool Self-Reported Sedentary Behaviors

Self-reported SB data were collected at three measurement time points during 1 academic year. A 3-month period was used to separate each of these periods. Measurement of self-reported SB was obtained using a modified version of the Adolescents Sedentary Activity Questionnaire (Hardy, Booth, & Okely, 2007). We only focused our attention on seven non-school-specific behaviors—namely, TV viewing, video games, study time, computer use, telephone communication time, mobile phone games, and passive

transport. Students were asked to think about a current week and to report how long they usually engaged in these seven different self-reported SBs before and after school on each weekday and each weekend day (Hardy et al., 2007). Time was added for each variable to yield the total time per week spent on each of the nonschool self-reported SBs.

### Statistical Analysis

Means and standard deviations of physical characteristics and sedentary activity values of the sample were computed first by city and gender. We conducted a series of multiple regression analyses on objective SB and different nonschool self-reported SB as dependent variables. Based on previous research (Pate et al., 2011), cohort, city, gender, age, BMI, and SES were selected as independent variables in the nonschool self-reported SB models. Temperature and rainfall were also included in the objective SB models.

To test the stability of objective SB (first and second moment) and different nonschool self-reported SB (first, second, and third moment), we conducted a series of repeated-measures general linear models on each dependent variable with gender, city, age, BMI, and SES as control variables. ANOVAs by schools were also calculated within each city for all dependent variables to give an idea of school differences within each city. The criterion for significance was set at  $p < .05$ . All statistical analyses were performed using the Statistical Package for the Social Sciences Version 15.0 for Windows.

## RESULTS

### Descriptive Statistics

Descriptive statistics of accelerometer-based measures of objective SB and nonschool self-reported SB by city and gender are shown in Table 1. It should be noted that a statistically significant city effect was found for BMI ( $p < .001$ ,  $\eta^2 = .021$ ; Huesca > Tarbes) and SES

TABLE 1  
Mean Scores and Standard Deviations of the Physical Characteristics of the Samples of the EPAPA Project

| Variables                | Huesca ( $n = 326$ )        |                    |                     | Tarbes ( $n = 320$ )     |                    |                     |
|--------------------------|-----------------------------|--------------------|---------------------|--------------------------|--------------------|---------------------|
|                          | All                         | Boys ( $n = 141$ ) | Girls ( $n = 185$ ) | All                      | Boys ( $n = 125$ ) | Girls ( $n = 195$ ) |
| Age (years)              | 14.33 (0.77)                | 14.39 (0.83)       | 14.28 (0.71)        | 14.28 (0.64)             | 14.26 (0.69)       | 14.29 (0.61)        |
| Height (cm)              | 164.35 (11.96) <sup>a</sup> | 168.47 (13.46)     | 161.28 (9.67)       | 163.04 (9.08)            | 165.61 (11.72)     | 161.4 (6.48)        |
| Weight (kg)              | 54.87 (9.23) <sup>a</sup>   | 59.43 (9.96)       | 51.47 (6.93)        | 51.35 (8.33)             | 53.58 (9.60)       | 49.97 (7.12)        |
| BMI (kg/m <sup>2</sup> ) | 20.02 (2.55) <sup>a</sup>   | 20.65 (2.75)       | 19.56 (2.29)        | 19.17 (2.35)             | 19.22 (2.41)       | 19.13 (2.31)        |
| SES <sup>b</sup>         | 2.74 (0.45)                 | 2.71 (0.49)        | 2.77 (0.42)         | 2.84 (0.37) <sup>a</sup> | 2.84 (0.37)        | 2.83 (0.37)         |

Note. EPAPA = Evaluation and Promotion of Adolescent Physical Activity; BMI = body mass index; SES = socioeconomic status.

<sup>a</sup> City differences (comparisons are made within objective sedentary behavior [SB] and subjective SB respectively).  $p < .05$  symbols are placed next to the highest value.

<sup>b</sup> Socioeconomic level has been divided into three categories: low affluence (1), medium affluence (2), and high affluence (3).

( $p < .001$ ,  $\eta^2 = .023$ ; Tarbes > Huesca) in univariate ANOVA. The chi-square test also showed that the gender distribution (boys/girls) in Huesca (48.18% vs. 51.82%) and Tarbes (41.39% vs. 58.61%) was statistically significantly different ( $\chi^2 = 3.86$ ,  $p < .05$ , OR = 0.76 [0.58–1.00]). However, all these effect sizes were small.

### Objective SB

Descriptive statistics are presented in Table 2. Higher daily levels of objective SB were found during the weekdays ( $566.22 \pm 72.67$  min/68.85% of the total wear time) compared with weekend days ( $468.38 \pm 110.17$  min/67.53% of the total wear time) in the total sample. Hence, differences in the number of daily minutes may be attributed to wear time differences. As a value of reference, a daily mean of  $544.56 \pm 69.80$  min of objective SB was found for the whole sample. This represents 68.95% of the total wear time. Total daily means in Huesca and Tarbes were  $549.90 \pm 72.35$  min (69.02%) and  $539.11 \pm 66.72$  min (68.91%), respectively.

Given the existence of statistically significant differences in objective wear time between cities, objective SB data were analyzed with percentages of daily time as the dependent variable to conduct multilevel analyses. First, we computed a model to predict weekly objective SB, with 1 year of data collection, city, gender, age, BMI, SES, ambient temperature, and rainfall as independent variables (see Table 3). Second, weekday and weekend period models were also calculated independently. Gender ( $p < .001$ ) and ambient temperature ( $p < .001$ ) emerged as the main predictors in all objective SB models, showing higher objective SB levels in girls and lower objective SB levels when ambient temperature was higher. The city did not emerge as a statistically significant predictor. Nevertheless, the ANOVAs showed that there were significant differences per school in the three objective SB models in Huesca (total,  $F = 5.56$ ,  $p < .001$ ,  $\eta^2 = .057$ ; weekday,  $F = 7.12$ ,  $p < .001$ ,  $\eta^2 = .065$ ; weekend,  $F = 4.86$ ,  $p < .001$ ,  $\eta^2 = .048$ ) and in the total ( $F = 4.06$ ,  $p < .05$ ,  $\eta^2 = .015$ ) and the weekday model ( $F = 5.06$ ,  $p < .01$ ,  $\eta^2 = .017$ ) in Tarbes. The proportion of variances explained by objective SB models were greater in the total week and during-the-week models ( $R^2 = .119$  and  $R^2 = .131$ , respectively) than in the weekend model ( $R^2 = .05$ ).

A statistically significant increase in objective SB was revealed in total ( $p < .001$ ,  $\eta^2 = .049$ ) and weekday ( $p < .001$ ,  $\eta^2 = .051$ ) objective SB measured between the two measurement points. No significant differences were found in the weekend objective SB.

### Nonschool Self-Reported SB

Table 4 shows the average minutes spent on different nonschool self-reported SB at each of the three time

TABLE 2  
Mean Scores and Standard Deviations of the Daily Minutes of Objective Sedentary Behaviors

| Variables                     | First Measure (n = 646) |                    |                    |                    |                    |                    | Second Measure (n = 646) |                    |                    |                    |                    |                    |
|-------------------------------|-------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
|                               | Huesca (n = 326)        |                    |                    | Tarbes (n = 320)   |                    |                    | Huesca (n = 326)         |                    |                    | Tarbes (n = 320)   |                    |                    |
|                               | All                     | Boys<br>(n = 141)  | Girls<br>(n = 185) | All                | Boys<br>(n = 125)  | Girls<br>(n = 195) | All                      | Boys<br>(n = 141)  | Girls<br>(n = 185) | All                | Boys<br>(n = 125)  | Girls<br>(n = 195) |
| Daily minutes of objective SB | 547.56<br>(72.67)       | 533.60<br>(72.39)  | 558.78<br>(70.84)  | 532.60<br>(61.36)  | 526.02<br>(57.84)  | 536.66<br>(63.25)  | 554.25<br>(70.05)        | 556.71<br>(75.09)  | 552.17<br>(65.75)  | 545.57<br>(71.20)  | 535.61<br>(73.50)  | 550.55<br>(69.74)  |
| Weekday                       | 571.57<br>(73.77)       | 555.73<br>(74.40)  | 584.18<br>(70.79)  | 556.64<br>(61.62)  | 545.88<br>(56.92)  | 563.29<br>(63.59)  | 580.82<br>(73.66)        | 581.12<br>(76.17)  | 580.57<br>(71.77)  | 573.16<br>(76.35)  | 562.15<br>(80.55)  | 578.66<br>(73.82)  |
| Weekend                       | 475.54<br>(109.12)      | 467.18<br>(106.21) | 482.60<br>(110.97) | 460.47<br>(103.34) | 466.44<br>(110.31) | 456.78<br>(98.89)  | 474.52<br>(109.48)       | 483.46<br>(124.02) | 466.99<br>(95.40)  | 462.81<br>(109.59) | 455.99<br>(112.18) | 466.22<br>(108.48) |

TABLE 3  
Predictors of Daily Objective Sedentary Behaviors During the Whole Week, Week, and Weekend

| Variables (n = 646)      | Model Objective SB Total Week |      |         | Model Objective SB During the Week |      |          | Model Objective SB the Weekend |      |         |
|--------------------------|-------------------------------|------|---------|------------------------------------|------|----------|--------------------------------|------|---------|
|                          | B                             | SE   | $\beta$ | B                                  | SE   | $\beta$  | B                              | SE   | $\beta$ |
| Intercept                | 78.80                         | 4.74 |         | 80.41                              | 4.59 |          | 73.49                          | 8.81 |         |
| Cohort <sup>a</sup>      | 2.09                          | 0.67 | .17     | 2.14                               | 0.64 | .177**   | 3.20                           | 1.23 | .15     |
| City <sup>b</sup>        | 0.23                          | 0.43 | .02     | -0.03                              | 0.42 | -.00     | 0.62                           | 0.80 | .03     |
| Sex <sup>c</sup>         | -3.24                         | 0.42 | -.30*** | -3.58                              | 0.40 | -.327*** | -2.16                          | 0.77 | -.11*   |
| Age (years)              | -0.610                        | 0.37 | -.08    | -0.72                              | 0.36 | -.10     | -0.29                          | 0.68 | -.02    |
| BMI (kg/m <sup>2</sup> ) | -0.07                         | 0.09 | -.04    | -0.05                              | 0.08 | -.02     | -0.21                          | 0.16 | -.06    |
| SES                      | -0.03                         | 0.14 | -.01    | -0.02                              | 0.13 | -.00     | -0.08                          | 0.25 | -.01    |
| Temperature              | -0.16                         | 0.05 | -.15**  | -0.14                              | 0.05 | -.13**   | -0.31                          | 0.09 | -.16*** |
| Rainfall                 | -0.01                         | 0.04 | -.01    | 0.03                               | 0.04 | .03      | -0.17                          | 0.07 | -.09    |

Note. Results have been calculated with percentages of daily SB. SB = sedentary behavior; B = unstandardized beta; SE = standard error;  $\beta$  = standardized beta; BMI = body mass index; SES = socioeconomic status.

<sup>a</sup>Second year of data collection as reference.

<sup>b</sup>Tarbes as reference.

<sup>c</sup>Boys as reference.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

measuring points. TV viewing was the most usual sedentary activity in this sample ( $103.49 \pm 58.23$  min), occupying almost one third of the total daily time ( $357.07 \pm 147.64$  min). After TV viewing, the two most time-consuming sedentary activities were studying ( $81.97 \pm 50.01$  min) and computer use ( $60.55 \pm 54.52$  min).

To predict each specific nonschool self-reported SB, we then computed a series of models with year, city, gender, age, BMI, and SES as independent variables (see Table 5 and 6). Results indicated that people with a higher BMI spent more time ( $p < .01$  to  $p < .05$ ) viewing TV or studying. Gender was significantly associated with almost all nonschool self-reported SB analyzed ( $p < .001$ ), showing an inverse association for some participants (i.e.,

boys spent more time playing video games whereas girls spent more time using the telephone to communicate). We also found a statistically significant city effect in the time spent on studying (Oscense > Tarbais;  $p < .001$ ) as well as in time spent on video games and telephone communication (Tarbais > Oscense;  $p < .05$  to  $p < .001$ ). Nevertheless, the ANOVAs calculated by school within each city showed that there were statistically significant differences per school in TV viewing ( $F = 5.30$ ,  $p < .001$ ,  $\eta^2 = .026$ ), video games ( $F = 3.48$ ,  $p < .01$ ,  $\eta^2 = .017$ ), studying ( $F = 6.32$ ,  $p < .001$ ,  $\eta^2 = .031$ ), computer use ( $F = 3.19$ ,  $p < .01$ ,  $\eta^2 = .016$ ), telephone communication ( $F = 17.90$ ,  $p < .001$ ,  $\eta^2 = .082$ ), mobile phone games ( $F = 4.74$ ,  $p < .001$ ,  $\eta^2 = .023$ ), and passive transport

TABLE 4  
Means and Standard Deviations of the Daily Minutes of Nonschool Self-Reported Sedentary Behaviors

| Variables (n = 646) | First Measure     |                   |                   |                   | Second Measure    |                   |                  |                  | Third Measure     |                   |                  |                  |
|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------------|------------------|-------------------|-------------------|------------------|------------------|
|                     | Huesca            |                   | Tarbes            |                   | Huesca            |                   | Tarbes           |                  | Huesca            |                   | Tarbes           |                  |
|                     | Boys              | Girls             | Boys              | Girls             | Boys              | Girls             | Boys             | Girls            | Boys              | Girls             | Boys             | Girls            |
| TV                  | 116.52<br>(53.18) | 102.96<br>(61.02) | 103.91<br>(57.17) | 108.90<br>(66.99) | 101.92<br>(49.44) | 81.84<br>(51.22)  | 99.09<br>(52.87) | 96.44<br>(63.51) | 104.95<br>(57.43) | 88.74<br>(47.56)  | 99.45<br>(61.02) | 99.10<br>(62.71) |
| Video games         | 67.61<br>(63.80)  | 14.44<br>(24.83)  | 69.58<br>(65.73)  | 22.44<br>(43.15)  | 57.27<br>(50.64)  | 11.99<br>(23.39)  | 73.99<br>(67.66) | 18.18<br>(30.60) | 53.99<br>(60.93)  | 10.04<br>(24.70)  | 74.64<br>(79.20) | 19.85<br>(39.54) |
| Studying            | 92.58<br>(42.53)  | 110.54<br>(52.98) | 56.92<br>(34.85)  | 66.15<br>(43.04)  | 95.97<br>(45.72)  | 115.79<br>(52.63) | 58.91<br>(40.12) | 73.73<br>(46.98) | 86.79<br>(44.09)  | 104.31<br>(48.86) | 57.60<br>(33.41) | 62.88<br>(43.42) |
| Computer use        | 54.68<br>(46.91)  | 74.90<br>(61.57)  | 44.58<br>(50.06)  | 60.74<br>(54.16)  | 47.86<br>(42.49)  | 67.79<br>(50.47)  | 31.41<br>(41.58) | 56.16<br>(50.93) | 47.66<br>(41.08)  | 76.13<br>(56.28)  | 41.27<br>(49.72) | 60.76<br>(52.88) |
| Phone communication | 13.76<br>(21.47)  | 30.52<br>(40.22)  | 29.65<br>(45.93)  | 68.54<br>(80.40)  | 20.41<br>(39.26)  | 30.13<br>(49.59)  | 34.21<br>(55.04) | 77.88<br>(77.63) | 25.41<br>(44.71)  | 40.01<br>(69.27)  | 41.20<br>(57.26) | 86.72<br>(82.53) |
| Mobile phone games  | 3.62<br>(8.45)    | 2.73<br>(8.20)    | 5.26<br>(18.71)   | 2.17<br>(10.08)   | 5.66<br>(14.59)   | 1.72<br>(5.84)    | 3.36<br>(9.47)   | 2.41<br>(8.77)   | 5.17<br>(12.37)   | 1.68<br>(5.60)    | 3.48<br>(11.05)  | 2.63<br>(9.06)   |
| Passive transport   | 22.00<br>(25.96)  | 15.68<br>(18.51)  | 21.15<br>(27.88)  | 21.24<br>(25.08)  | 21.33<br>(24.92)  | 20.56<br>(24.05)  | 28.66<br>(27.92) | 23.16<br>(22.49) | 20.95<br>(28.64)  | 16.80<br>(18.59)  | 27.09<br>(28.31) | 24.76<br>(23.35) |

TABLE 5

Predictors of Nonschool Self-Reported Sedentary Behaviors During the Total Week: TV Time, Video Game Time, Study Time, Computer Time

| Variables ( <i>n</i> = 646) | Model TV Time |           |         | Model Video Game Time |           |         | Model Study Time |           |          | Model Computer Time |           |          |
|-----------------------------|---------------|-----------|---------|-----------------------|-----------|---------|------------------|-----------|----------|---------------------|-----------|----------|
|                             | <i>B</i>      | <i>SE</i> | $\beta$ | <i>B</i>              | <i>SE</i> | $\beta$ | <i>B</i>         | <i>SE</i> | $\beta$  | <i>B</i>            | <i>SE</i> | $\beta$  |
| Intercept                   | 36.18         | 49.66     | —       | −30.86                | 43.23     | —       | 315.14           | 36.66     | —        | −88.04              | 45.61     | —        |
| Cohort <sup>a</sup>         | −6.56         | 6.20      | −.05*   | 1.28                  | 5.39      | .01     | 2.58             | 4.56      | .02      | −2.18               | 5.69      | −.02     |
| City <sup>b</sup>           | 6.17          | 4.48      | .05     | 6.49                  | 3.90      | .06*    | −43.64           | 3.30      | −.44***  | −8.25               | 4.11      | −.07*    |
| Sex <sup>c</sup>            | 1.68          | 4.38      | .01     | 53.45                 | 3.82      | .46***  | −13.57           | 3.23      | −.136*** | −18.08              | 4.03      | −.159*** |
| Age (years)                 | 2.75          | 3.87      | .03     | −1.58                 | 3.37      | −.02    | −9.47            | 2.85      | −.14     | 11.44               | 3.56      | .15**    |
| BMI (kg/m <sup>2</sup> )    | 2.55          | 0.87      | .11**   | 0.29                  | 0.75      | .01     | −1.06            | 0.64      | −.06*    | 0.09                | 0.79      | .00      |
| SES                         | −1.40         | 1.44      | −.04    | −0.10                 | 1.25      | −.00    | 0.21             | 1.06      | .01      | 4.42                | 1.32      | .12**    |

Note. *B* = unstandardized beta; *SE* = standard error;  $\beta$  = standardized beta; BMI = body mass index; SES = socioeconomic status.

<sup>a</sup> Second year of data collection as reference.

<sup>b</sup> Tarbes as reference.

<sup>c</sup> Boys as reference.

\**p* < .05. \*\**p* < .01. \*\*\**p* < .001.

TABLE 6

Predictors of Nonschool Self-Reported Sedentary Behaviors During the Total Week: Telephone Communication Time, Telephone Game Time, and Passive Transport Time

| Variables ( <i>n</i> = 646) | Model Telephone Communication |           |         | Model Mobile Phone Games |           |         | Model Passive Transport |           |         |
|-----------------------------|-------------------------------|-----------|---------|--------------------------|-----------|---------|-------------------------|-----------|---------|
|                             | <i>B</i>                      | <i>SE</i> | $\beta$ | <i>B</i>                 | <i>SE</i> | $\beta$ | <i>B</i>                | <i>SE</i> | $\beta$ |
| Intercept                   | −174.49                       | 46.55     | —       | −1.98                    | 9.92      | —       | 31.34                   | 20.14     | —       |
| Cohort <sup>a</sup>         | −7.62                         | 5.81      | −.06    | −1.17                    | 1.24      | −.04    | −3.24                   | 2.51      | −.06    |
| City <sup>b</sup>           | 31.31                         | 4.20      | .26***  | −0.19                    | 0.90      | −.01    | 3.51                    | 1.82      | .07     |
| Sex <sup>c</sup>            | −28.05                        | 4.11      | −.23*** | 1.87                     | 0.88      | .08*    | 1.85                    | 1.78      | .04     |
| Age (years)                 | 13.73                         | 3.63      | .16***  | 0.37                     | 0.77      | .02     | −2.00                   | 1.57      | −.06    |
| BMI (kg/m <sup>2</sup> )    | 0.75                          | 0.81      | .03     | 0.03                     | 0.17      | .01     | 0.53                    | 0.35      | .06     |
| SES                         | 2.57                          | 1.35      | .07     | 0.03                     | 0.29      | .00     | 1.12                    | 0.59      | .07*    |

Note. *B* = unstandardized beta; *SE* = standard error;  $\beta$  = standardized beta; BMI = body mass index; SES = socioeconomic status.

<sup>a</sup> Second year of data collection as reference.

<sup>b</sup> Tarbes as reference.

<sup>c</sup> Boys as reference.

\**p* < .05. \*\*\**p* < .001.

( $F = 39.25$ ,  $p < .001$ ,  $\eta^2 = .165$ ) in Huesca. Statistical differences were also found per school in TV viewing ( $F = 10.69$ ,  $p < .001$ ,  $\eta^2 = .018$ ), video games ( $F = 15.81$ ,  $p < .001$ ,  $\eta^2 = .026$ ), studying ( $F = 6.21$ ,  $p < .01$ ,  $\eta^2 = .011$ ), and computer use ( $F = 6.84$ ,  $p < .001$ ,  $\eta^2 = .012$ ) in Tarbes. The telephone communication model, mobile phone games model, and passive transport model did not show significant differences per school in Tarbes. Lastly, SES significantly affected some behaviors (studying, computer use, and passive transport time;  $p < .001$  to  $p = .049$ ), showing that individuals with higher SES spent more time on these activities. The proportion of variance explained in the different models was different. The model of video games time ( $R^2 = .20$ ), study time ( $R^2 = .22$ ), and telephone communication ( $R^2 = .14$ ) showed an acceptable percentage of explained variance. However, the model of TV time ( $R^2 = .03$ ), computer time ( $R^2 = .06$ ), mobile phone games ( $R^2 = .01$ ), and passive

transport time ( $R^2 = .02$ ) showed a low explained variance and therefore a poor model fit.

With respect to the stability of these behaviors, it should be pointed out, based on repeated-measures general linear models, that TV ( $p < .001$ ,  $\eta^2 = .048$ ) and study time ( $p < .001$ ,  $\eta^2 = .025$ ; decreasing tendency), on the one hand, and telephone communication time ( $p < .001$ ,  $\eta^2 = .047$ ; increasing tendency), on the other hand, showed statistically significant differences across the different measurement points.

## DISCUSSION

This study had two main purposes. We identified and compared the demographic and environmental correlates that predict (a) objective SB, and (b) nonschool self-reported SB in a sample of adolescents from two midsized

cities located in France and Spain. Then we tested the stability of objective SB and nonschool self-reported SB across an academic year. In the first part of the discussion, objective SB results will be discussed. Secondly, we will explore the main statistically significant findings in terms of nonschool self-reported SB.

Our accelerometer data show a higher total mean value of objective SB ( $544.56 \pm 69.80$  min/day, or 68.95% of the total wear time) than that found in other previous non-European studies (Matthews et al., 2008) conducted on adolescents (450 min/day, or 56% of the total wear time). However, to our knowledge and despite the lack of French studies with which to compare our findings, a recent study conducted on Spanish adolescents (Martinez-Gómez et al., 2012) provided similar results (522 min/day, or 66% of total wear time). Our findings show that objective SB is similar between Tarbes and Huesca. Further research is warranted among other European or non-European countries.

Gender and ambient temperature appeared as the most statistically significant correlates of objective SB. Little research has been carried out in Europe on the correlates of objective SB in adolescents (Rey-Lopez et al., 2011), so comparisons are difficult. With regard to gender, the higher levels of objective SB found in girls contrast with other studies on adolescents where no differences were found (Pate et al., 2011). However, a similar relation (higher objective SB levels in girls) was shown in countries such as Estonia (van Sluijs et al., 2010) and England (King et al., 2011). Studies using self-reported total SB also present inconsistent results (Pate et al., 2011). Although boys are usually more physically active than girls, considering the fact that physical activity and SB are not exclusive (Sisson et al., 2011), it could be suggested that intervention programs aimed to reduce SB should focus especially on girls. Further research on this point is warranted.

Our results also suggest that climate conditions may influence objective SB (Tucker & Gilliland, 2007). Other studies (Devís-Devís, Peiró-Velert, Beltran-Carrillo, & Tomas, 2009) have suggested the importance of climate when making international physical activity comparisons, and seasonal effects have already been tested in some studies (Biddle et al., 2009; King et al., 2011). With regards to objective SB, a recent review revealed equivocal seasonal effects due to methodological inconsistency (Rich, Griffiths, & Dezauteux, 2012). However, to our knowledge, no specific climate correlates such as daily ambient temperature or rainfall have been used in the way we have used them in our study. Higher ambient temperatures in mid-European countries may encourage adolescents to go outdoors and substitute indoor leisure behaviors with other less sedentary activities. Therefore, seasonality may be considered as an important factor to consider in objective SB reduction programs. Nevertheless, this influence could be completely different in other more climate-extreme countries or periods

of the year, so cross-cultural comparisons across different seasons are warranted.

Finally, it should be noted that total and weekday objective SB significantly increased during the year. Despite difficult comparisons due to the small number of objective SB stability studies and their disparity in terms of assessment methods, the data reported by Biddle et al. (2010) seem not to be inconsistent with our results. Nevertheless, the lack of studies and the high percentages of objective SB observed in our data call for further studies.

As a second main point in the discussion, this study also provides information about the prevalence of some of the most common nonschool self-reported SBs among Oscense and Tarbais adolescents. Our findings indicate that different statistically significant correlates were found between the various nonschool self-reported SB assessed, even though small percentages of explained variances were found in some models. Nevertheless, this fact suggests the necessity to assess multiple behaviors to improve SB research.

Values reported for adolescents' TV viewing (Huesca, 33.64% of the sample > 2 hr/day; Tarbes, 35.25% of the sample > 2 hr/day) are not supported by the only cross-cultural study (Vereecken, Todd, Roberts, Mulvihill, & Maes, 2006) conducted on this behavior, which indicates higher percentages in Huesca (~60%) and Tarbes (~50%). Equivocal data exist in literature (Fulton et al., 2009; Rey-Lopez et al., 2011). Different ways of assessing TV time (i.e., including or not including video time in this category) or differences due to age may be the reasons for these diverse results. Special attention should be paid to behaviors relating to new technologies, like mobile phone use (13% of total sedentary prevalence) or computer time (17%), for which the percentages are worryingly close to TV viewing rates. Consequently, a wide range of nonschool self-reported SBs should be analyzed to provide a more extensive understanding of these behaviors.

Significant differences between countries were found in the nonschool self-reported SBs analyzed, in contrast with other studies (Melkevik et al., 2010). Study time (Huesca > Tarbes) and time spent on video games and telephone communication (Tarbes > Huesca) showed significantly different values. Cultural hypotheses such as different homework burdens or cheaper accessibility to some communication devices may explain these differences.

Concerning gender, our results suggest that nonschool self-reported SB seems to be gender-specific. Local effect size values seem to support this idea. Behaviors related to time spent on video games and phone games were higher in boys than in girls. This is consistent with former results, as video games have been demonstrated to be predominantly a masculine behavior (Patnode et al., 2011). Unfortunately, this behavior may displace physical activity time (Melkevik et al., 2010). Indeed, special attention should be given to this behavior in the boy population to control their use. On the other hand, girls showed higher levels of other nonschool

self-reported SB such as study time, computer time, or time spent on telephone communication, which is consistent with other recent findings (Patnode et al., 2011). The existence of these nonschool self-reported SB differences could be explained by the higher engagement in sedentary socializing behaviors in girls compared with boys (Biddle, O'Connell, & Braithwaite, 2011). Nevertheless, a clear gender difference in terms of the use by adolescents of mobile phones has not been observed (Devís-Devís et al., 2009). In addition, no gender differences were found in relation to TV viewing, although other findings have reported higher TV viewing time for boys (Biddle et al., 2011; Patnode et al., 2011; Vereecken et al., 2006). Further research in this area is warranted.

This study also identified an association between BMI, SES, and some of the nonschool self-reported SBs studied. It should be noted that TV viewing time was greater for individuals with higher BMI. TV viewing has been widely related to being overweight (Fulton et al., 2009; Pate et al., 2011). Special attention should be paid to overweight and obese individuals in intervention programs. With regard to SES, there is still controversy about its effects on screen-time behaviors (Pate et al., 2011). This may be related to the fact that screen time has frequently been composed of different behaviors such as TV viewing, playing video games, and using computers, which vary significantly for adolescents (Rey-Lopez et al., 2011). Our findings showed that individuals with higher SES levels spent more time on the computer, but no statistically significant effect was found in relation to TV viewing time. It could be hypothesized that TV use in some cultures is already generalized for the whole population while other newer technological devices are only accessible for people with higher SES levels. Further research is required on this topic.

A statistically significant age effect in relation to time spent on computers and mobile phones should also be highlighted. This suggests that time spent on these activities may increase during adolescence, probably replacing the apparent reduction in TV viewing time that occurs after the viewing peak that takes place during the ages of 9 to 13 years (Gorely et al., 2004). In this regard, it is also important to underline that two behaviors showed statistically significant differences throughout the year (TV and study time [decreasing tendency]). The decrease in TV viewing is therefore consistent with the slight decline in mid-to-late adolescence suggested previously (Biddle et al., 2010; Gorely et al., 2004). Furthermore, it is likely that time freed due to this decrease may be transferred to the use of other technologies (e.g., computers and mobile phones; Biddle et al., 2010), and this may result in stability or an increase in overall nonschool self-reported SB in the long term as suggested by the age effect. This could be supported by a recent study (Trang et al., 2013), which showed an increase in daily nonschool SB throughout adolescence. Further

monitoring is needed in Europe to determine trends related to these behaviors during adolescence.

The major strength of this study is the use of the same measurement device and the same procedures for data cleaning and analysis within a study sample from two European cities. Another strength is the dual approach followed using objective and self-reported methods of SB measurement. This may enable us to gain access to better indexes of sedentary lifestyle (Biddle et al., 2011). Nevertheless, some limitations need to be mentioned. We collected data from two different European cities, and as a result, it may not be possible to generalize the results in terms of the respective city. In addition, common limitations related to accelerometry should be mentioned, especially when objective SB is measured. Firstly, for our study, we used one of the most common and accepted objective SB cutoff points ( $< 100$  cpm; Pate et al., 2008), although some controversy still exists regarding this issue. Secondly, due to the fact that accelerometers do not detect body position, some periods of low movement may include some time spent standing still, resulting in an overestimation of sedentary time. Thirdly, given that objective SB only has two time points of measure, it should be acknowledged that our results cannot provide the longitudinal stability of the behavior but only represent the differences between two time points. Fourthly, the proportion of explained variance in some models is small, so one should be careful with the effectiveness of the analyzed variables to effectively modify SB. Finally, the range of ages used should be acknowledged, as this limits the potential of the conclusions.

## CONCLUSIONS

This study reveals that girls presented higher levels of objective SB than boys and that as ambient temperature rose, objective SB decreased. The objective SB levels increased throughout the period of time that was measured. Moreover, different patterns of nonschool self-reported SB in the two European cities were identified. From the cross-cultural point of view and to reduce SB in adolescents, these differences should determine an adapted intervention program. In addition, different sets of correlates, such as gender, BMI, or SES have been significantly related to specific subjective behaviors. Furthermore, the overall nonschool self-reported SB seems to show a stable or even an increasing tendency during adolescence, with possible transferability of time between SB. This contributes to our understanding of the nature of adolescent sedentariness.

These findings reinforce the idea that culturally adapted interventions are needed when devising programs for tackling adolescents' objective and nonschool self-reported SB in different contexts. Our results suggest that a single strategy aimed at reducing nonschool self-reported SB is unlikely to be effective across Europe because behaviors

differ significantly between countries (van Sluijs et al., 2010). Consequently, further research into national differences between European countries should be carried out to establish SB patterns in adolescence.

### WHAT DOES THIS ARTICLE ADD?

Two main findings from this study have contributed to the understanding of objective and nonschool self-reported adolescent SB correlates from two different European countries. First of all, it has been specifically shown how some nonschool self-reported SBs (video games, studying, and the use of mobile phones to communicate) are culturally different. In addition, other correlates such as gender, BMI, and SES should also be considered as statistically significant predictors of some nonschool self-reported SB, as well as of objective SB.

Secondly, this article also supports a statistically significant increase in objective SB levels throughout a short period of time (6 months). Nonschool self-reported SB levels also varied significantly during this short period of time. However, evolution tendencies were different depending on the behaviors. TV, video games, and studying decreased while the use of mobile phones to communicate increased. The variability of these specific nonschool self-reported SB levels suggests that it is likely that the time freed due to decreases in some nonschool self-reported SBs may be transferred to the use of recent nonschool self-reported SBs more related to new technologies, such as the use of mobile phones to communicate. The observed increase in objective SB levels calls for the need to design SB reduction programs that include cultural factors.

### FUNDING

The EPAPA project was financially supported by the provinces of Aragón in Spain and Aquitaine in France as cross-border cooperation projects to help us compile data. This study was also supported by grants from the Government of Aragon, the Comunidad de Trabajo de los Pirineos (CTP [Pyrenees Work Community]), and Caja de Ahorros de la Inmaculada (CAI [Savings Bank of Aragon]).

### REFERENCES

- Babey, S. H., Hastert, T. A., & Wolstein, J. (2013). Adolescent sedentary behaviors: Correlates differ for television viewing and computer use. *Journal of Adolescent Health, 52*, 70–76.
- Beardsley, L. M., & Pedersen, P. (1997). Health and culture-centered intervention. In J. W. Berry, M. H. Segall, & C. Kagitçibasi (Eds.), *Handbook of cross-cultural psychology: Social behaviour and applications* (2nd ed., pp. 413–448). Boston, MA: Allyn & Bacon.
- Biddle, S. J., Gorely, T., Marshall, S. J., & Cameron, N. (2009). The prevalence of sedentary behavior and physical activity in leisure time: A study of Scottish adolescents using ecological momentary assessment. *Preventive Medicine, 48*, 151–155.
- Biddle, S. J., O'Connell, S., & Braithwaite, R. E. (2011). Sedentary behaviour interventions in young people: A meta-analysis. *British Journal of Sports Medicine, 45*, 937–942.
- Biddle, S. J., Pearson, N., Ross, G. M., & Braithwaite, R. (2010). Tracking of sedentary behaviours of young people: A systematic review. *Preventive Medicine, 51*, 345–351.
- Currie, C., Molcho, M., Boyce, W., Holstein, B., Torsheim, T., & Richter, M. (2008). Researching health inequalities in adolescents: The development of the Health Behaviour in School-Aged Children (HBSC) Family Affluence Scale. *Social Science & Medicine, 66*, 1429–1436.
- Devís-Devís, J., Peiró-Velert, C., Beltran-Carrillo, V. J., & Tomas, J. M. (2009). Screen media time usage of 12–16 year-old Spanish school adolescents: Effects of personal and socioeconomic factors, season and type of day. *Journal of Adolescence, 32*, 213–231.
- Fulton, J. E., Wang, X., Yore, M. M., Carlson, S. A., Galuska, D. A., & Caspersen, C. J. (2009). Television viewing, computer use, and BMI among U.S. children and adolescents. *Journal of Physical Activity & Health, 6*, 28–35.
- Gebremariam, M. K., Totland, T. H., Andersen, L. F., Bergh, I. H., Bjeland, M., Grdland, M., ... Lien, N. (2012). Stability and change in screen-based sedentary behaviours and associated factors among Norwegian children in the transition between childhood and adolescence. *BMC Public Health, 12*, 104–112.
- Gorely, T., Marshall, S. J., & Biddle, S. J. (2004). Couch kids: Correlates of television viewing among youth. *International Journal of Behavioral Medicine, 11*, 152–163.
- Hardy, L. L., Booth, M. L., & Okely, A. D. (2007). The reliability of the Adolescent Sedentary Activity Questionnaire (ASAQ). *Preventive Medicine, 45*, 71–74.
- King, A. C., Parkinson, K. N., Adamson, A. J., Murray, L., Besson, H., Reilly, J. J., & Basterfield, L. (2011). Correlates of objectively measured physical activity and sedentary behaviour in English children. *European Journal of Public Health, 21*, 424–431.
- Leatherdale, S. T. (2010). Factors associated with communication-based sedentary behaviors among youth: Are talking on the phone, texting, and instant messaging new sedentary behaviors to be concerned about? *Journal of Adolescent Health, 47*, 315–318.
- Maier, J. M., Markey, J. C., & Ebert-May, D. (2013). The other half of the story: Effect size analysis in quantitative research. *CBE-Life Sciences Education, 12*, 345–351.
- Martinez-Gómez, D., Eisenmann, J. C., Healy, G. N., Gomez-Martinez, S., Diaz, L. E., Dunstan, D. W., ... Marcos, A. (2012). Sedentary behaviors and emerging cardiometabolic biomarkers in adolescents. *Journal of Pediatrics, 160*, 104–110.
- Matthews, C. E., Chen, K. Y., Freedson, P. S., Buchowski, M. S., Beech, B. M., Pate, R. R., & Troiano, P. (2008). Amount of time spent in sedentary behaviors in the United States, 2003–2004. *American Journal of Epidemiology, 167*, 875–881.
- Melkevik, O., Torsheim, T., Iannotti, R. J., & Wold, B. (2010). Is spending time in screen-based sedentary behaviors associated with less physical activity: A cross national investigation. *International Journal of Behavioral Nutrition and Physical Activity, 7*, 46–55.
- Pate, R. R., Mitchell, J. A., Byun, W., & Dowda, M. (2011). Sedentary behaviour in youth. *British Journal of Sports Medicine, 45*, 906–913.
- Pate, R. R., O'Neill, J. R., & Lobelo, F. (2008). The evolving definition of 'sedentary'. *Exercise and Sport Sciences Reviews, 36*, 173–178.
- Patnode, C. D., Lytle, L., Erickson, D., Sirard, J., Barr-Anderson, D., & Story, M. (2011). Physical activity and sedentary activity patterns among children and adolescents: A latent class analysis approach. *Journal of Physical Activity & Health, 8*, 457–467.
- Rey-Lopez, J. P., Tomas, C., Vicente-Rodriguez, G., Gracia-Marco, L., Jimenez-Pavon, D., Perez-Llamas, F., ... Moreno, L. A. (2011). Sedentary behaviours and socio-economic status in Spanish adolescents: The AVENA study. *European Journal of Public Health, 21*, 151–157.

- Rich, C., Griffiths, L. J., & Dezaux, C. (2012). Seasonal variation in accelerometer-determined sedentary behaviour and physical activity in children: A review. *International Journal of Behavioral Nutrition and Physical Activity*, 9, 49–56.
- Sisson, S. B., Broyles, S. T., Baker, B. L., & Katzmarzyk, P. T. (2011). Television, reading, and computer time: Correlates of school-day leisure-time sedentary behavior and relationship with overweight in children in the U.S. *Journal of Physical Activity & Health*, 8(Suppl. 2), 188–197.
- Trang, N. H. H. D., Hong, T. K., van der Ploeg, H. P., Hardy, L. L., Kelly, P. J., & Dibley, M. J. (2013). Longitudinal sedentary behaviour changes in adolescents in Ho Chi Ming City. *American Journal of Preventive Medicine*, 44, 223–230.
- Treuth, M. S., Schmitz, K., Catellier, D. J., McMurray, R. G., Murray, D. M., Almeida, M. J., ... Pate, R. (2004). Defining accelerometer thresholds for activity intensities in adolescent girls. *Medicine & Science in Sports & Exercise*, 36, 1259–1266.
- Trost, S. G., McIver, K. L., & Pate, R. R. (2005). Conducting accelerometer-based activity assessments in field-based research. *Medicine & Science in Sports & Exercise*, 37, 531–543.
- Tucker, P., & Gilliland, J. (2007). The effect of season and weather on physical activity: A systematic review. *Public Health*, 121, 909–922.
- van Sluijs, E. M., Page, A., Ommundsen, Y., & Griffin, S. J. (2010). Behavioural and social correlates of sedentary time in young people. *British Journal of Sports Medicine*, 44, 747–755.
- Vereecken, C. A., Todd, J., Roberts, C., Mulvihill, C., & Maes, L. (2006). Television viewing behaviour and associations with food habits in different countries. *Public Health Nutrition*, 9, 244–250.
- West, P., Reeder, A. I., Milne, B. J., & Poulton, R. (2002). Worlds apart: A comparison between physical activities among youth in Glasgow, Scotland and Dunedin, New Zealand. *Social Science & Medicine*, 54, 607–619.

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