

Original article

# Social correlates of sedentary behavior in young people: The UP&DOWN study

Verónica Cabanas-Sánchez<sup>a,b,\*</sup>, Laura García-Cervantes<sup>a</sup>, Laura Esteban-Gonzalo<sup>c</sup>,  
María José Girela-Rejón<sup>d</sup>, José Castro-Piñero<sup>e</sup>, Óscar L. Veiga<sup>a</sup>

<sup>a</sup> Department of Physical Education, Sport and Human Movement, Autonomous University of Madrid, Madrid 28049, Spain

<sup>b</sup> Research Centre in Physical Activity, Health and Leisure (CIAFEL), Faculty of Sport, University of Porto, Porto 4200-450, Portugal

<sup>c</sup> Nursing Department, Faculty of Biomedical and Health Sciences, Universidad Europea de Madrid, Villaviciosa de Odón, Madrid 28670, Spain

<sup>d</sup> Department of Didactic of Corporal Expression, Faculty of Education Sciences, University of Granada, Granada 18010, Spain

<sup>e</sup> Department of Physical Education, School of Education, University of Cadiz, Puerto Real, Cádiz 11519, Spain

Received 17 September 2018; revised 19 November 2018; accepted 11 December 2018

Available online 19 March 2019

## Abstract

**Purpose:** The aim of the present study was to analyze the associations of youths' sedentary behavior (SB) with parents' and siblings' SB and physical activity (PA), as well as the associations of youths' coparticipation with parents, siblings, and friends in PA and SB with youths' SB.

**Methods:** The sample consisted of 1543 youths ( $12.02 \pm 2.51$  years; 788 boys) enrolled in the baseline cohort of the UP&DOWN study. SB was assessed by accelerometry and questionnaire. Participants reported the time spent by their parents and siblings watching television, playing videogames, surfing the Internet, sitting/resting, and doing PA. Further, participants reported coparticipation with parents, siblings, and friends in these activities. Linear mixed models, including school and city as random effects, were performed.

**Results:** Parents' television time was positively associated with youths' screen-based SB. Coparticipation with friends in playing videogames (in boys) and in surfing the Internet (in girls) showed a positive association with screen-based SB and a negative association with educational-based SB. Moreover, coparticipation with siblings and friends in PA was inversely associated with accelerometer-based SB in boys and girls.

**Conclusion:** Our results emphasize the important role of social modeling in the development of sedentary lifestyles in youths. Interventions aimed at reducing health risk behaviors in youths could be more effective if they are oriented from a social perspective that involves their families and networks of their closest friends.

2095-2546/© 2020 Published by Elsevier B.V. on behalf of Shanghai University of Sport. This is an open access article under the CC BY-NC-ND license. (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Keywords:** Friends; Parents; Sedentary behavior; Siblings; Social environment

## 1. Introduction

Sedentary behavior (SB) has been defined as any waking behavior characterized by low energy expenditure ( $\leq 1.5$  metabolic equivalents) while in a sitting, reclining, or lying posture.<sup>1</sup> Therefore, SB is contemplated as a differentiated construct to the lack of physical activity (PA), with specific correlates and with independent effects on health.<sup>2</sup> SB has been related to impaired anthropometric, cardiometabolic, fitness, and social health indicators in youths.<sup>3,4</sup> Thus, in recent decades, interest in identifying the correlates of SB among children and adolescents has increased, considering

that knowledge of the factors associated with SB could guide interventions aimed at improving the lifestyle patterns of young people.<sup>5</sup>

The family environment is particularly important in the development of healthy habits in young people, because during the early stages of young people's lives, parents are the main source of support and influence in the development of their children's attitudes and behaviors.<sup>6</sup> Thus, parental modeling is an important social factor that influences the development of active and sedentary habits in young people.<sup>7,8</sup> It contributes to the socialization of children, gives that children are inspired to imitate their parents' conduct after observing it.<sup>9</sup> However, parental modelling not only offers opportunities for observational learning, but also includes coparticipation, which is defined as the time shared in certain behaviors.<sup>9</sup>

Peer review under responsibility of Shanghai University of Sport.

\* Corresponding author.

E-mail address: [veronica.cabanas84@gmail.com](mailto:veronica.cabanas84@gmail.com) (V. Cabanas-Sánchez).

Associations between parental and youth behaviors have been described, with most previous studies focusing on PA.<sup>10</sup> By contrast, the influence of siblings on the lifestyles of their brothers and sisters has been much more rarely analyzed.<sup>11</sup> In this regard, significant correlations between PA levels among siblings have been identified,<sup>12</sup> but research on the associations of SB among siblings has yielded scant and inconclusive results.<sup>13</sup>

In addition to family influences, friendship networks can be an important factor in the development of health-related behaviors among young people.<sup>14</sup> During transition to adolescence, the time spent with parents decreases and the time interacting with peers increases, so that although parental influence does not completely disappear, the influence of friends on individual behaviors gains a large relevance.<sup>15</sup> The motivation and praise received from friends, as well as observation of their friends' behaviors and coparticipation in their friends' activities, have been described as predictors of PA levels in young people.<sup>16</sup> Nevertheless, the influence of friendship networks on SB has been sparingly examined, and the few previous studies that have done so have reported mixed results.<sup>15</sup>

Accordingly, the aim of the present study was to identify the social correlates of SB in young people. Thus, we analyzed the associations between accelerometer-based and self-reported SB among youths and their parents' and siblings' SB and PA, as well as the associations between young people's coparticipation with their parents, siblings, and friends in relevant activities and the SB of these youths.

## 2. Methods

### 2.1. Participants

Participants selected for this study were enrolled in the baseline cohort of the UP&DOWN study,<sup>17</sup> a 3-year longitudinal study designed to assess the impact of PA and SB on health indicators, as well as to identify the psychoenvironmental and genetic determinants of PA and SB. Cross-sectional data from this study were collected from September 2011 to June 2012.

A total of 2225 youths (age 6–18 years) from 23 primary schools in Cádiz (1st- and 4th-grade students) and 18 secondary schools in Madrid (7th- and 10th-grade students) participated in the UP&DOWN study. The study involved public schools ( $n=32$ ) and concerted/private schools ( $n=9$ ). Schools were located in urban areas ( $n=24$ ) as well as rural areas ( $n=17$ ). Younger children (age 6–8 years) did not complete the self-reported questionnaires due to possible bias; thus, participants in the present study included 1543 Spanish youths (788 boys), age  $12.02 \pm 2.51$  years, who had complete data at baseline.

Study protocols were approved by the Bioethics Committee of the National Research Council (Madrid, Spain), the Ethics Committee of the Hospital Puerta de Hierro (Madrid, Spain) and the Committee for Research Involving Human Subjects at the University of Cádiz (Cádiz, Spain). Parents/guardians and participants signed a written informed consent before participating in the study.

### 2.2. Accelerometer-based leisure time SB

Objectively measured SB data were obtained by Actigraph accelerometers, models GT1M, GT3X and GT3X+ (ActiGraph LLC, Pensacola, FL, USA). Previous research has confirmed a strong agreement among the 3 models without additional calibration.<sup>18</sup>

Participants were instructed to wear the accelerometer at the lower back for 7 consecutive days, removing it during sleep and water-based activities. Data were downloaded and processed using Actilife software (Version 5.2.2; ActiGraph LLC). The epoch duration was set at 2 s in GT1M models and at 30 Hz in GT3X and GT3X+ models. Before analyses, all data were re-integrated into a 10-s epoch.<sup>19</sup> After deleting data on nonwear time,<sup>20</sup> the inclusion criterion was defined as  $\geq 3$  days of recording (with 1 weekend day), with a minimum of 10 h of valid registrations per day.<sup>19</sup> Accelerometer files were subjected to a filter to remove the records stored during school time, and average sedentary time for valid weekdays and weekend days was determined using the cut-point value of  $< 100$  counts per minute.<sup>21</sup> SB was then computed as follows:  $((\text{weekday SB} \times 5) + (\text{weekend SB} \times 2))/7$ .

### 2.3. Self-reported leisure time SB

Participants completed the Youth Leisure-time Sedentary Behavior Questionnaire.<sup>22</sup> This questionnaire evaluates the amount of leisure time spent in 12 SBs that could be merged into 4 categories: (1) screen-based SB (watching television (TV), playing computer/video games, and surfing the Internet); (2) educational-based SB (doing homework/studying with a computer, doing homework/studying without a computer, and reading for fun); (3) social-based SB (sitting and talking, talking on the telephone, and listening to music); and (4) other-based SB (sitting to rest, doing cognitive hobbies, and traveling on motorized transport).

Participants were instructed to think back over the previous week and report the estimated average time devoted to each behavior during weekdays and weekends, separately. To diminish an over-reporting phenomenon, the questionnaire responses were adjusted to leisure time before performing analysis.<sup>22</sup> The average time spent per day on each behavior was calculated as follows:  $((\text{weekday time} \times 5) + (\text{weekend time} \times 2))/7$ .

### 2.4. Perceived PA and SB of parents and siblings

Participants indicated, on a 5-point Likert scale (1 = *never*, 2 = *seldom*, 3 = *sometimes*, 4 = *often*, 5 = *very often*), how often their parents and siblings are watching TV, playing video-games, surfing the Internet, sitting/resting, and doing PA. Participants were instructed to answer only about the parents/guardians and siblings with whom they lived.

### 2.5. Coparticipation in PA and SBs with parents, siblings, and friends

Participants reported, on a 5-point Likert scale (1 = *never*, 2 = *seldom*, 3 = *sometimes*, 4 = *often*, 5 = *very often*), how often they coparticipated with parents, siblings, and best friends in

the following behaviors: watching TV, playing videogames, surfing the Internet, sitting/resting, and doing PA.

### 2.6. Other variables

Sex and age were recorded. Socioeconomic status was assessed by the Family Affluence Scale.<sup>23</sup>

### 2.7. Statistical analyses

Statistical analyses were performed using SPSS Statistics Version 23.0 for Windows (IBM Corp., Armonk, NY, USA), with level of significance set at  $p < 0.05$ . Descriptive statistics are presented as mean  $\pm$  SD or percentages. Because preliminary analyses showed interaction by sex in certain associations, all analyses were conducted separately for boys and girls. No interaction was found for other variables (e.g., family structure, age of parents, number of siblings, or difference in age between siblings).

Owing to the hierarchical nature of the data (participants at Level 1, schools at Level 2, and city at Level 3), we used linear mixed models, including school and city as random effects, to determine the correlates of each SB. The associations were analyzed in 2 steps. First, bivariate analyses were conducted to select factors associated with SB. In the second step, significant or borderline significant terms in bivariate analyses ( $p < 0.10$ ) were combined in multivariable models. Age and socioeconomic status were included as covariates in all models. Analyses for accelerometer-based SB were additionally adjusted for accelerometer wearing time.

Before performing the multivariable analyses, multicollinearity between the independent variables was analyzed by checking Pearson's correlations ( $r$ ). A correlation of  $r > 0.6$  was considered as an indicator of multicollinearity.<sup>24</sup> In case of multicollinearity, the variable more strongly associated with the dependent variable was included in the analysis. Correlations ranged from  $-0.117$  to  $0.480$  except for sitting/resting with parents and sitting/resting with siblings, which were significantly correlated in both boys ( $r = 0.661$ ) and girls ( $r = 0.630$ ). Therefore, sitting/resting with siblings was removed from the multivariable model for social-based SB in boys, and sitting/resting with parents was removed from the multivariable models for social-based SB and other-based SB in girls.

## 3. Results

Descriptive statistics of the sample are shown in Table 1. The main effects of the univariate analyses for boys are included in Supplementary Table 1. In the multivariate analyses for boys (Table 2), TV time of parents was positively associated with accelerometer-based SB ( $p = 0.013$ ), screen-based SB ( $p = 0.032$ ), and time watching TV ( $p < 0.01$ ). The time spent sitting/resting by siblings was positively related with TV time ( $p = 0.013$ ) and negatively with educational-based SB ( $p = 0.016$ ). Coparticipation with parents ( $p < 0.01$ ) and friends ( $p < 0.01$ ) in sitting/resting showed a positive relationship with social-based SB. Coparticipation with friends in playing videogames was positively associated with screen-based SB ( $p < 0.01$ ) and time playing videogames ( $p < 0.01$ ), and

negatively associated with educational-based SB ( $p = 0.043$ ). Coparticipation with siblings in watching TV showed a positive relation with other-based SB ( $p = 0.040$ ), whereas coparticipation with friends in surfing the Internet was positively associated with the time invested by boys in this behavior ( $p < 0.01$ ). Conversely, the PA level of siblings was negatively related with screen-based SB ( $p = 0.020$ ) and time surfing the Internet ( $p = 0.030$ ). Coparticipation with parents in PA was negatively associated with screen-based SB ( $p < 0.01$ ) and time playing videogames ( $p = 0.042$ ), whereas coparticipation with siblings in PA showed a negative relationship with accelerometer-based SB ( $p = 0.035$ ). Coparticipation with friends in PA was inversely related with accelerometer-based SB ( $p = 0.042$ ), screen-based SB ( $p < 0.01$ ), time watching TV ( $p = 0.042$ ), time playing videogames ( $p < 0.01$ ), and other-based SB ( $p = 0.047$ ).

The main effects of the univariate analyses for girls are included in Supplementary Table 2. In the multivariate analyses for girls (Table 3), the time spent watching TV by parents was positively related with screen-based SB ( $p = 0.023$ ) and time watching TV ( $p = 0.033$ ). Coparticipation with parents in watching TV was positively associated with girls' TV time ( $p = 0.043$ ), whereas coparticipation with siblings in watching TV was positively related with accelerometer-based SB ( $p = 0.036$ ). The time spent sitting/resting by parents showed a positive association with social-based SB ( $p < 0.01$ ) and a negative relationship with educational-based SB ( $p = 0.035$ ), whereas the time spent sitting/resting by siblings was positively related with accelerometer-based SB ( $p = 0.037$ ), screen-based SB ( $p = 0.043$ ), and other-based SB ( $p < 0.01$ ). Coparticipation with siblings ( $p = 0.040$ ) and friends ( $p = 0.039$ ) in playing videogames was positively associated with the time spent in this behavior by girls, and coparticipation with siblings in surfing the Internet showed a positive association with other-based SB ( $p = 0.024$ ). Coparticipation with friends in surfing the Internet was positively related with screen-based SB ( $p = 0.045$ ) and time surfing the Internet ( $p < 0.01$ ), and negatively associated with educational-based SB ( $p = 0.047$ ). Coparticipation with friends in sitting/resting showed a positive association with social-based SB ( $p = 0.013$ ). In contrast, coparticipation with siblings in PA was inversely associated with accelerometer-based SB ( $p = 0.030$ ), screen-based SB ( $p < 0.01$ ), time watching TV ( $p = 0.012$ ), and time playing videogames ( $p = 0.018$ ). Finally, coparticipation with friends in PA showed a negative relationship with accelerometer-based SB ( $p = 0.048$ ), screen-based SB ( $p < 0.01$ ), and time surfing the Internet ( $p = 0.048$ ).

## 4. Discussion

The objective of the present study was to identify the social correlates of accelerometer-based and self-reported SB (including screen-, educational-, social-, and other-based SB) in a sample of Spanish youths. SB of parents and siblings, as well as coparticipation with parents, siblings, and friends, in SB was positively associated with SB in young people. Conversely, coparticipation with parents, siblings, and friends in PA demonstrated inverse relationships with youths' SB. The increased number of associations established emphasizes the

Table 1  
Descriptive statistics of the sample (mean  $\pm$  SD).

	All ( <i>n</i> = 1543)	Boys ( <i>n</i> = 788)	Girls ( <i>n</i> = 755)	<i>p</i> for sex*
<b>Age (year)</b>	12.02 $\pm$ 2.51	12.05 $\pm$ 2.51	11.98 $\pm$ 2.51	0.581
<b>SES (Family Affluence Scale) (0–7)</b>	5.19 $\pm$ 1.48	5.20 $\pm$ 1.48	5.18 $\pm$ 1.47	0.391
<b>SBs (min/day)</b>				
Accelerometer-based SB <sup>a</sup>	451.53 $\pm$ 47.60	443.23 $\pm$ 48.63	460.22 $\pm$ 44.92	< <b>0.001</b>
Screen-based SB	171.89 $\pm$ 115.67	184.71 $\pm$ 118.67	158.51 $\pm$ 110.97	< <b>0.001</b>
Watching TV	92.61 $\pm$ 81.15	98.16 $\pm$ 82.53	86.82 $\pm$ 79.33	<b>0.006</b>
Playing videogames	34.02 $\pm$ 51.00	44.07 $\pm$ 56.80	23.52 $\pm$ 41.66	< <b>0.001</b>
Surfing the Internet	46.44 $\pm$ 68.08	42.48 $\pm$ 65.84	49.97 $\pm$ 70.27	<b>0.043</b>
Educational-based SB	149.47 $\pm$ 108.10	138.62 $\pm$ 106.00	160.79 $\pm$ 109.17	< <b>0.001</b>
Social-based SB	84.23 $\pm$ 73.65	75.83 $\pm$ 68.03	93.00 $\pm$ 78.18	< <b>0.001</b>
Other-based SB	34.64 $\pm$ 42.16	35.16 $\pm$ 43.88	34.10 $\pm$ 40.31	0.622
<b>Family PA and SB (1–5)</b>				
Behaviors of parents				
Watching TV	2.69 $\pm$ 0.80	2.69 $\pm$ 0.82	2.68 $\pm$ 0.77	0.823
Playing videogames	1.44 $\pm$ 0.76	1.47 $\pm$ 0.76	1.42 $\pm$ 0.75	0.212
Surfing the Internet	1.92 $\pm$ 0.94	1.94 $\pm$ 0.95	1.90 $\pm$ 0.93	0.427
Sitting/resting	2.12 $\pm$ 0.89	2.13 $\pm$ 0.93	2.11 $\pm$ 0.85	0.732
Physical activity	2.60 $\pm$ 1.06	2.51 $\pm$ 1.04	2.69 $\pm$ 1.07	<b>0.001</b>
Behaviors of siblings				
Watching TV	3.10 $\pm$ 1.07	3.10 $\pm$ 1.07	3.10 $\pm$ 1.08	0.972
Playing videogames	2.46 $\pm$ 1.26	2.50 $\pm$ 1.26	2.43 $\pm$ 1.28	0.352
Surfing the Internet	2.62 $\pm$ 1.37	2.62 $\pm$ 1.39	2.62 $\pm$ 1.36	0.975
Sitting/resting	2.19 $\pm$ 1.10	2.16 $\pm$ 1.11	2.21 $\pm$ 1.09	0.496
Physical activity	3.08 $\pm$ 1.22	3.02 $\pm$ 1.22	3.14 $\pm$ 1.21	0.088
<b>Coparticipation in PA and SB (1–5)</b>				
Coparticipation with parents				
Watching TV	2.68 $\pm$ 0.89	2.68 $\pm$ 0.89	2.68 $\pm$ 0.89	0.982
Playing videogames	1.39 $\pm$ 0.73	1.44 $\pm$ 0.76	1.34 $\pm$ 0.69	<b>0.007</b>
Surfing the Internet	1.48 $\pm$ 0.81	1.49 $\pm$ 0.82	1.46 $\pm$ 0.80	0.540
Sitting/resting	2.92 $\pm$ 1.03	2.83 $\pm$ 1.05	3.01 $\pm$ 1.00	<b>0.001</b>
Physical activity	2.16 $\pm$ 1.10	2.16 $\pm$ 1.10	2.17 $\pm$ 1.11	0.837
Coparticipation with siblings				
Watching TV	2.92 $\pm$ 1.07	2.91 $\pm$ 1.08	2.94 $\pm$ 1.05	0.699
Playing videogames	2.03 $\pm$ 1.19	2.21 $\pm$ 1.27	1.84 $\pm$ 1.06	< <b>0.001</b>
Surfing the Internet	1.80 $\pm$ 1.10	1.76 $\pm$ 1.09	1.85 $\pm$ 1.10	0.141
Sitting/resting	2.72 $\pm$ 1.14	2.63 $\pm$ 1.12	2.81 $\pm$ 1.14	<b>0.009</b>
Physical activity	2.42 $\pm$ 1.27	2.43 $\pm$ 1.29	2.41 $\pm$ 1.26	0.767
Coparticipation with friends				
Watching TV	1.83 $\pm$ 0.91	1.81 $\pm$ 0.90	1.84 $\pm$ 0.91	0.510
Playing videogames	2.09 $\pm$ 1.15	2.50 $\pm$ 1.20	1.67 $\pm$ 0.92	< <b>0.001</b>
Surfing the Internet	2.52 $\pm$ 1.32	2.41 $\pm$ 1.30	2.64 $\pm$ 1.32	<b>0.001</b>
Sitting/resting	3.19 $\pm$ 1.19	2.86 $\pm$ 1.14	3.52 $\pm$ 1.15	< <b>0.001</b>
Physical activity	3.42 $\pm$ 1.23	3.70 $\pm$ 1.15	3.13 $\pm$ 1.24	< <b>0.001</b>

Notes: <sup>a</sup> Adjusted for wearing time.

\* Differences between boys and girls were tested by *t* test. Significant values are indicated in bold.

Abbreviations: PA = physical activity; SB = sedentary behavior; SES = socioeconomic status; TV = television.

important role of social modelling in the development of sedentary lifestyles in young people.

Parenting practices may influence the health-related behaviors of young people through several mechanisms, such as parental modelling, parental support for PA or parental cognitions, awareness, restrictions, and policies.<sup>10</sup> A recent systematic review consistently revealed that parents' own TV time is positively associated with their child's screen time.<sup>7</sup> Our findings support this statement, in that the TV time of parents was positively related with youths' screen-based SB and TV time both in boys and girls. Lee et al.<sup>8</sup> suggested that this association could also be result of indirect factors (e.g., home environment). However, influences of parental modelling on youths' objectively measured

SB have not been investigated extensively. We found that parents' TV time was positively associated with accelerometer-based SB in boys, but not in girls. Formerly, it has been described that girls are less affected by parental support than boys.<sup>25</sup>

Otherwise, parental participation in PA was not associated with SB in boys or girls. This is in line with previous studies, where no significant associations were established between PA of parents and total SB,<sup>26</sup> screen-based SB,<sup>27</sup> or non-screen-based SB<sup>28</sup> by young people. Tandon et al.<sup>29</sup> found that participation of parents in PA was not related to total SB, SB at home, or screen-based SB of their children; however, parental support (i.e., observing their children while engaging in PA, encouraging them to participate in sport activities, and



Table 2  
Multivariate social correlates of SBs in boys ( $n = 788$ ).

	Accelerometer-based SB <sup>a</sup>	Screen-based SB	TV	Videogames	Internet	Educational-based SB	Social-based SB	Other-based SB
<b>Behaviors of parents</b>								
Watching TV	<b>5.49 (2.20)*</b>	<b>10.42 (4.14)*</b>	<b>11.31 (4.41)**</b>	—	—	—	—	—
Playing videogames	—	—	—	—	—	—	—	—
Surfing the Internet	—	—	—	—	—	—	—	—
Sitting/resting	—	—	—	—	—	—	—	2.75 (2.12)
Physical activity	—	-6.76 (5.45)	—	—	-0.82 (2.77)	—	—	—
<b>Behaviors of siblings</b>								
Watching TV	—	5.53 (4.98)	4.60 (3.76)	—	—	-0.47 (4.50)	—	—
Playing videogames	—	—	—	—	—	-3.98 (3.90)	—	—
Surfing the Internet	—	—	—	1.78 (1.71)	—	—	—	—
Sitting/resting	—	6.29 (4.43)	<b>7.88 (3.17)*</b>	—	—	<b>-9.94 (4.11)*</b>	—	2.05 (1.81)
Physical activity	—	<b>-10.60 (4.55)*</b>	—	-2.10 (2.12)	<b>-5.08 (2.33)*</b>	—	—	—
<b>Coparticipation with parents</b>								
Watching TV	—	—	—	—	—	—	—	—
Playing videogames	—	—	—	—	—	—	—	—
Surfing the Internet	—	—	—	—	—	—	—	—
Sitting/resting	—	—	—	—	—	—	<b>7.62 (2.54)**</b>	—
Physical activity	—	<b>-14.24 (5.40)**</b>	-4.78 (3.23)	<b>-4.72 (2.25)*</b>	-3.11 (2.76)	—	—	—
<b>Coparticipation with siblings</b>								
Watching TV	—	—	2.33 (3.60)	—	—	—	—	<b>4.30 (1.75)*</b>
Playing videogames	—	—	—	—	—	—	—	—
Surfing the Internet	—	—	—	—	—	—	—	—
Sitting time	—	—	—	-2.21 (2.15)	—	—	<sup>b</sup>	—
Physical activity	<b>-3.17 (1.50)*</b>	-1.35 (4.68)	—	-1.39 (2.22)	-1.29 (2.36)	—	—	—
<b>Coparticipation with friends</b>								
Watching TV	—	—	—	—	—	—	—	1.90 (2.03)
Playing videogames	—	<b>10.48 (4.09)**</b>	—	<b>10.73 (2.08)**</b>	—	<b>-7.18 (3.31)*</b>	—	—
Surfing the Internet	—	—	—	—	<b>5.70 (2.02)**</b>	—	—	—
Sitting/resting	—	—	—	—	—	—	<b>8.56 (2.34)**</b>	—
Physical activity	<b>-3.40 (1.63)*</b>	<b>-15.54 (4.44)**</b>	<b>-5.91 (2.04)*</b>	<b>-7.24 (2.08)**</b>	-3.20 (2.25)	—	—	<b>-3.18 (1.33)*</b>

Notes: Values are unstandardized by standard errors (regression coefficients). All analyses were adjusted for age and socioeconomic status (Family Affluence Scale).

<sup>a</sup> Additionally adjusted for wearing time; “—” variable not introduced in final models ( $p > 0.10$  in univariate models).

<sup>b</sup> Variable removed from the model owing to multicollinearity. \*  $p < 0.05$ , \*\*  $p < 0.01$ . Significant values are indicated in bold.

Abbreviations: SB = sedentary behavior; TV = television.

providing transportation to sport facilities) was associated with reduced SB in youths. Therefore, it is possible that parents' support for PA might have a greater impact on reducing SB in youths than their parents' own participation in PA.<sup>30–32</sup>

Additionally, time spent sitting/resting by siblings was identified as a positive correlate of TV viewing in boys, and of screen-based SB and accelerometer-based SB in girls. Several studies have analyzed the influence of siblings on youths' PA, establishing positive associations between PA levels of young people and their siblings,<sup>12,16,33</sup> but the analysis of siblings' influence on SB of children and adolescents has been negligible in previous research, which has been fundamentally limited to analyzing the relationships between the presence of siblings in home and the youths' SB.<sup>34</sup> Our results add evidence by indicating that siblings could exert an independent and significant social influence on SB of young people.

In contrast, engaging in SBs as a shared family activity, where family members watch TV or play videogames together, has been identified as an important influence on SB of youths.<sup>9,35–37</sup> We found that coparticipation with parents and siblings in watching TV was positively associated with girls' TV time and accelerometer-based SB, respectively. In trying to spend time with their children, parents may opt to share

behaviors that do not require a large amount of money, time, or energy.<sup>38</sup> It is possible for parents to think that sharing time with their children in activities such as watching TV is a social activity that provides family bonding. Thus, Dubas and Gerris<sup>39</sup> reported that parents tend to increase TV covieving with their children beginning in early adolescence with the objective of compensating for the decrease in shared time in other social contexts. At early ages, the association may be due to parents' intention to control their children's access to certain content.<sup>40</sup> The challenge, therefore, is making parents aware of the detrimental effects of excessive sedentary time and encouraging parents to identify more beneficial alternatives that allow them to share time with their children in a healthier context.

In addition, positive associations between coparticipation with parents in PA and young people's PA levels have been reiterated;<sup>10,41</sup> however, there is very little evidence regarding how coparticipation in PA with parents or siblings displaces SB in youth. To the best of our knowledge, this is the first study to consider the relationship between coparticipation with parents and siblings in PA and the time invested by young people in a wide range of SBs. We found that coparticipation with parents in PA was negatively associated with screen-based SB in boys, but not in girls. In contrast, coparticipation in PA with

Table 3  
Multivariate social correlates of SBs in girls ( $n = 755$ ).

	Sedentary behaviors of girls							
	Accelerometer-based SB <sup>a</sup>	Screen-based SB	TV	Videogames	Internet	Educational-based SB	Social-based SB	Other-based SB
Behaviors of parents								
Watching TV	—	<b>17.33 (7.61)*</b>	<b>9.44 (3.18)*</b>	4.66 (2.66)	—	−3.32 (6.63)	—	—
Playing videogames	—	9.28 (7.22)	—	—	—	—	—	—
Surfing the Internet	3.05 (1.84)	—	—	3.07 (2.17)	2.17 (2.87)	—	—	—
Sitting/resting	—	−0.87 (6.41)	—	—	4.28 (3.05)	<b>−12.62 (5.97)*</b>	<b>10.11 (3.76)**</b>	1.26 (2.07)
Physical activity	—	−5.88 (4.91)	—	−1.86 (1.85)	—	—	—	—
Behaviors of siblings								
Watching TV	—	0.42 (5.34)	5.28 (3.39)	—	—	—	−5.01 (3.07)	—
Playing videogames	—	—	—	0.76 (1.66)	—	—	−4.58 (2.69)	—
Surfing the Internet	—	0.75 (3.95)	—	—	—	—	—	0.75 (1.38)
Sitting/resting	<b>3.07 (1.54)*</b>	<b>8.39 (3.99)*</b>	4.04 (3.22)	—	—	−4.42 (4.66)	—	<b>6.23 (1.64)**</b>
Physical activity	—	2.66 (4.28)	—	—	−2.14 (2.24)	—	—	—
Coparticipation with parents								
Watching TV	—	0.21 (6.23)	<b>8.18 (3.99)*</b>	—	—	—	—	—
Playing videogames	—	—	—	—	—	—	9.52 (5.27)	—
Surfing the Internet	—	—	—	—	—	−6.73 (6.15)	7.57 (4.30) <sub>b</sub>	—
Sitting/resting	—	—	—	—	—	—	—	<sub>b</sub>
Physical activity	—	0.26 (5.26)	−4.04 (3.40)	—	—	—	—	—
Coparticipation with siblings								
Watching TV	<b>3.92 (1.70)*</b>	5.47 (5.50)	—	—	—	—	—	—
Playing videogames	1.41 (1.75)	—	—	<b>5.44 (2.26)*</b>	—	—	—	—
Surfing the Internet	—	—	—	1.05 (2.01)	—	—	—	<b>3.75 (1.47)*</b>
Sitting/resting	—	—	—	—	—	—	2.99 (2.74)	1.81 (1.47)
Physical activity	<b>−2.76 (1.40)*</b>	<b>−15.03 (4.72)**</b>	<b>−7.70 (3.05)*</b>	<b>−3.95 (1.66)*</b>	−2.50 (2.19)	—	—	—
Coparticipation with friends								
Watching TV	—	—	—	—	—	−1.66 (5.53)	—	—
Playing videogames	—	3.38 (5.49)	—	<b>5.12 (2.18)*</b>	—	—	—	—
Surfing the Internet	1.45 (1.26)	<b>8.78 (4.37)*</b>	—	—	<b>11.41 (2.26)**</b>	<b>−7.97 (3.12)*</b>	—	—
Sitting/resting	—	—	—	—	2.59 (2.51)	—	<b>7.45 (2.98)*</b>	—
Physical activity	<b>−2.49 (1.18)*</b>	<b>−11.74 (4.09)**</b>	−4.59 (2.75)	—	<b>−4.32 (2.08)*</b>	—	—	—

Notes: Values are unstandardized by standard errors (regression coefficients). All analyses were adjusted for age and socioeconomic status (Family Affluence Scale).

<sup>a</sup> Additionally adjusted for wearing time; “—” variable not introduced in final models ( $p > 0.10$  in univariate models).

<sup>b</sup> Variable removed from the model owing to multicollinearity. \*  $p < 0.05$ , \*\*  $p < 0.01$ . Significant values are indicated in bold.

Abbreviations: SB = sedentary behavior; TV = television.

siblings presented stronger associations with SB in girls than in boys. Thus, girls who reported a high level of coparticipation with siblings in PA showed decreased levels of accelerometer-based SB, screen-based SB, time watching TV, and time playing videogames. It has been stated that boys find greater support from peers for PA than girls;<sup>42</sup> thus, coparticipation with siblings may offer greater opportunities for PA to girls who have less social support from their friends.

Friendship networks can be an important factor in the development of health-related behaviors in youth.<sup>14,15,33</sup> In the present study, the number of relationships identified between youths' SB and the time shared with friends in active behaviors or SBs was elevated. Coparticipation with friends in playing videogames or surfing the Internet was identified as a positive correlate of screen-based SB in boys and girls, respectively. These outcomes are similar to those reported by Marques et al.,<sup>43</sup> who established that time-sharing with friends using computers and playing videogames is associated with increased screen time in young people. Our results also suggest that those children and adolescents who spent a large

amount of time with their friends in screen behaviors may be doing so at the risk of displacing their academic obligations.

Conversely, no associations were found between youths' SB and the time spent watching TV with friends. The lack of associations may be due to the low prevalence of coparticipation with friends in watching TV. Among the behaviors shared with friends that were evaluated, coparticipation in watching TV was the least prevalent, indicating that this behavior is more likely to be carried out alone or in the company of family members. A previous study showed that only 6%–9% of the time spent by young people watching TV is done so while watching with friends.<sup>44</sup> It is possible that friends more directly impact the content that young people watch rather than total time watching TV. In a qualitative study, parents suggested that their children's friends influenced the types of programs and films their children watched, but most of parents acknowledged that the time their children spent watching TV was not affected by their children's friends.<sup>45</sup>

Finally, we found that coparticipation with friends in PA was negatively associated with accelerometer-based SB and

screen-based SB in both boys and girls. It is noteworthy that although the SB of parents or siblings (e.g., time sitting/resting) and coparticipation with friends in SB (e.g., playing videogames or surfing the Internet) were negatively associated with educational-based SB, coparticipation with relatives or friends in PA did not demonstrate negative relationships with the time invested by youth in educational or social behaviors. This finding suggests that sharing time with parents, siblings, or friends in PA could decrease SB or screen-based SB in young people without displacing other productive SBs (such as study time) and without reducing social communications.

The most relevant limitations of the present study are related to the use of a convenience sample and the cross-sectional design of study, both of which limit the generalizability of the results across the population and the establishment of any causal relations. The limitations inherent in accelerometry as an objective method of assessing SB should be considered. For example, the use of accelerometry might produce reactivity in the participants, the period registered might not reflect the participants' complete behavioral patterns, accelerometers might misclassify certain types of activities (e.g., bicycling or holding a burden), and the decisions made regarding the analysis procedures (i.e., epoch, cut-points and nonwear time detection) might influence the results.<sup>46</sup> However, self-reported information (e.g., self-reported SBs) is subjected to social desirability and recall biases. Moreover, information about the behaviors of parents, siblings, and friends was reported by the participants, so the information might also be biased.

The main strengths of the present study include the relatively large and heterogeneous sample of children and adolescents, as well as the wide range of SBs assessed (including accelerometer-derived and self-reported measures). In addition, information on the behaviors of diverse socialization agents (i.e., parents, siblings, and friends), assessment of SBs other than screen-based SB (e.g., sitting/resting) and coparticipation in both SB and PA has been included in this study.

## 5. Conclusion

The social environment of young people may have a significant influence on their acquisition of sedentary habits. In this study, boys and girls whose parents invested a great deal of time in watching TV accumulated more screen-based SB. Moreover, coparticipation with friends in SBs (e.g., playing videogames or surfing the Internet) was related to more screen-based SB and less educational-based SB. In contrast, coparticipation with parents, siblings, or friends in PA showed a beneficial association with sedentary patterns in boys and girls. Therefore, interventions aimed at reducing health risk behaviors in children and adolescents might be more effective if they are designed to include a social perspective involving families and closest friends.

## Acknowledgments

The authors gratefully acknowledge the youths, families, and teachers who participated in this study. The UP&DOWN study was supported by a DEP 2010-21662-C04-00 grant from the National Plan for Research, Development and Innovation

(R+D+i) of the Spanish Ministry (MICINN). VCS and LGC were supported by pre-doctoral grants (FPI) from the Autonomous University of Madrid. The funding organizations played no role in the collection, analysis, or interpretation of the data, and they had no involvement in decisions regarding the approval or disapproval of the publication of the finished manuscript.

## Authors' contributions

All authors listed on the manuscript meet the International Committee of Medical Journal Editors (ICMJE) requirements for authorship. VCS participated in the design of the study, coordinated and participated in the acquisition of data, carried out the analyses and interpretation of data, and drafted the manuscript; LGC, LEG, and MJGR contributed to the acquisition of data; JCP participated in the conception and design of the study and contributed to the acquisition of data; OLV participated in the conception and design of the study and contributed to the acquisition of data. All authors have read and approved the final version of the manuscript, and they agree with the order of presentation of the authors.

## Competing interests

The authors declare that they have no competing interests.

## Supplementary materials

Supplementary tables associated with this article can be found in the online version at <https://doi.org/10.1016/j.jshs.2019.03.005>.

## References

1. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, et al. Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome. *Int J Behav Nutr Phys Act* 2017;**14**:75. doi:10.1186/s12966-017-0525-8.
2. van der Ploeg HP, Hillsdon M. Is sedentary behaviour just physical inactivity by another name? *Int J Behav Nutr Phys Act* 2017;**14**:142. doi:10.1186/s12966-017-0601-0.
3. Carson V, Hunter S, Kuzik N, Gray CE, Poitras VJ, Chaput JP, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. *Appl Physiol Nutr Metab* 2016;**41** (Suppl. 3):S240–65.
4. van Ekris E, Altenburg TM, Singh AS, Proper KI, Heymans MW, Chinapaw MJ. An evidence-update on the prospective relationship between childhood sedentary behaviour and biomedical health indicators: a systematic review and meta-analysis. *Obes Rev* 2016;**17**:833–49.
5. Salmon J, Tremblay MS, Marshall SJ, Hume C. Health risks, correlates, and interventions to reduce sedentary behavior in young people. *Am J Prev Med* 2011;**41**:197–206.
6. Markward M, McMillan L, Markward N. Social support among youth. *Child Youth Serv Rev* 2003;**25**:571–87.
7. Xu H, Wen LM, Rissel C. Associations of parental influences with physical activity and screen time among young children: a systematic review. *J Obes* 2015;**2015**:546925. doi:10.1155/2015/546925.
8. Lee EY, Hesketh KD, Rhodes RE, Rinaldi CM, Spence JC, Carson V. Role of parental and environmental characteristics in toddlers' physical activity and screen time: Bayesian analysis of structural equation models. *Int J Behav Nutr Phys Act* 2018;**15**:17. doi:10.1186/s12966-018-0649-5.
9. Jago R, Edwards MJ, Urbanski CR, Sebire SJ. General and specific approaches to media parenting: a systematic review of current measures, associations with screen-viewing, and measurement implications. *Child Obes* 2013;**9**(Suppl.1):S51–72.

10. Mitchell J, Skouteris H, McCabe M, Ricciardelli LA, Milgrom J, Baur LA, et al. Physical activity in young children: a systematic review of parental influences. *Early Child Dev Care* 2012;**182**:1411–37.
11. Hopwood MJ, Farrow D, MacMahon C, Baker J. Sibling dynamics and sport expertise. *Scand J Med Sci Sports* 2015;**25**:724–33.
12. Davison KK, Schmalz DL. Youth at risk of physical inactivity may benefit more from activity-related support than youth not at risk. *Int J Behav Nutr Phys Act* 2006;**3**:5. doi:10.1186/1479-5868-3-5.
13. De Decker E, De Craemer M, De Bourdeaudhuij I, Wijndaele K, Duvinaige K, Koletzko B, et al. Influencing factors of screen time in preschool children: an exploration of parents' perceptions through focus groups in six European countries. *Obes Rev* 2012;**13**:75–84.
14. Salvy SJ, de la Haye K, Bowker JC, Hermans RC. Influence of peers and friends on children's and adolescents' eating and activity behaviors. *Physiol Behav* 2012;**106**:369–78.
15. Sawka KJ, McCormack GR, Nettel-Aguirre A, Hawe P, Doyle-Baker PK. Friendship networks and physical activity and sedentary behavior among youth: a systematized review. *Int J Behav Nutr Phys Act* 2013;**10**:130. doi:10.1186/1479-5868-10-130.
16. Duncan SC, Duncan TE, Strycker LA. Sources and types of social support in youth physical activity. *Health Psychol* 2005;**24**:3–10.
17. Castro-Piñero J, Carbonell-Baeza A, Martínez-Gomez D, Gómez-Martínez S, Cabanas-Sánchez V, Santiago C, et al. Follow-up in healthy schoolchildren and in adolescents with DOWN syndrome: psycho-environmental and genetic determinants of physical activity and its impact on fitness, cardiovascular diseases, inflammatory biomarkers and mental health; the UP&DOWN Study. *BMC Public Health* 2014;**14**:400. doi:10.1186/1471-2458-14-400.
18. Robusto KM, Trost SG. Comparison of three generations of ActiGraph™ activity monitors in children and adolescents. *J Sports Sci* 2012;**30**:1429–35.
19. Cain KL, Sallis JF, Conway TL, Van Dyck D, Calhoun L. Using accelerometers in youth physical activity studies: a review of methods. *J Phys Act Health* 2013;**10**:437–50.
20. Choi L, Liu Z, Matthews CE, Buchowski MS. Validation of accelerometer wear and nonwear time classification algorithm. *Med Sci Sports Exerc* 2011;**43**:357–64.
21. Evenson KR, Catellier DJ, Gill K, Ondrak KS, McMurray RG. Calibration of two objective measures of physical activity for children. *J Sports Sci* 2008;**26**:1557–65.
22. Cabanas-Sánchez V, Martínez-Gómez D, Esteban-Cornejo I, Castro-Piñero J, Conde-Caveda J, Veiga ÓL. Reliability and validity of the Youth Leisure-time Sedentary Behavior Questionnaire (YLSBQ). *J Sci Med Sport* 2018;**21**:69–74.
23. Currie C, Molcho M, Boyce W, Holstein B, Torsheim T, Richter M. Researching health inequalities in adolescents: the development of the Health Behaviour in School-Aged Children (HBSC) family affluence scale. *Soc Sci Med* 2008;**66**:1429–36.
24. Tabachnick B, Fidell L. *Using multivariate statistics*. New York, NY: Harper Collins; 1996.
25. Cong Z, Feng D, Liu Y, Esperat MC. Sedentary behaviors among Hispanic children: influences of parental support in a school intervention program. *Am J Health Promot* 2012;**26**:270–80.
26. Van Sluijs EM, Page A, Ommundsen Y, Griffin SJ. Behavioural and social correlates of sedentary time in young people. *Br J Sports Med* 2010;**44**:747–55.
27. He M, Piché L, Beynon C, Harris S. Screen-related sedentary behaviors: children's and parents' attitudes, motivations, and practices. *J Nutr Educ Behav* 2010;**42**:17–25.
28. Leatherdale ST. 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? *J Adolesc Health* 2010;**47**:315–8.
29. Tandon P, Grow HM, Couch S, Glanz K, Sallis JF, Frank LD, et al. Physical and social home environment in relation to children's overall and home-based physical activity and sedentary time. *Prev Med* 2014;**66**:39–44.
30. Bounova A, Michalopoulou M, Agelousis N, Kourtessis T, Gourgoulis V. The parental role in adolescent screen related sedentary behavior. *Int J Adolesc Med Health* 2016;**30**. doi:10.1515/ijamh-2016-0031.
31. Jiménez-Pavón D, Fernández-Alvira JM, te Velde SJ, Brug J, Bere E, Jan N, et al. Associations of parental education and parental physical activity (PA) with children's PA: the ENERGY cross-sectional study. *Prev Med* 2012;**55**:310–4.
32. Timperio A, van Stralen MM, Brug J, Bere E, Chinapaw MJ, De Bourdeaudhuij I, et al. Direct and indirect associations between the family physical activity environment and sports participation among 10-12 year-old European children: testing the EnRG framework in the ENERGY project. *Int J Behav Nutr Phys Act* 2013;**10**:15. doi:10.1186/1479-5868-10-15.
33. MacDonald-Wallis K, Jago R, Sterne JA. Social network analysis of childhood and youth physical activity: a systematic review. *Am J Prev Med* 2012;**43**:636–42.
34. Fernandes RA, Reichert FF, Monteiro HL, Freitas Júnior IF, Cardoso JR, Ronque ER, et al. Characteristics of family nucleus as correlates of regular participation in sports among adolescents. *Int J Public Health* 2012;**57**:431–5.
35. Gentile DA, Walsh DA. A normative study of family media habits. *J Appl Dev Psychol* 2002;**23**:157–78.
36. Granich J, Rosenberg M, Knuiman MW, Timperio A. Individual, social, and physical environment factors associated with electronic media use among children: sedentary behavior at home. *J Phys Act Health* 2011;**8**:613–25.
37. Hardy LL, Baur LA, Garnett SP, Crawford D, Campbell KJ, Shrewsbury VA, et al. Family and home correlates of television viewing in 12-13 year old adolescents: the Nepean Study. *Int J Behav Nutr Phys Act* 2006;**3**:24. doi:10.1186/1479-5868-3-24.
38. Brockman R, Jago R, Fox KR, Thompson JL, Cartwright K, Page AS. "Get off the sofa and go and play": family and socioeconomic influences on the physical activity of 10-11 year old children. *BMC Public Health* 2009;**9**:253. doi:10.1186/1471-2458-9-253.
39. Dubas JS, Gerris JR. Longitudinal changes in the time parents spend in activities with their adolescent children as a function of child age, pubertal status, and gender. *J Fam Psychol* 2002;**16**:415–27.
40. Nikken P, Schols M. How and why parents guide the media use of young children. *J Child Fam Stud* 2015;**24**:3423–35.
41. Yao CA, Rhodes RE. Parental correlates in child and adolescent physical activity: a meta-analysis. *Int J Behav Nutr Phys Act* 2015;**12**:10. doi:10.1186/s12966-015-0163-y.
42. Fredricks JA, Simpkins S, Eccles JS. Family socialization, gender, and participation in sports and instrumental music. In: Cooper CR, Coll CTG, Bartko WT, Davis H, Chatman C, editors. *Developmental pathways through middle childhood: rethinking contexts and diversity as resources*. Mahwah, NJ: Erlbaum; 2005.p.35–48.
43. Marques A, Sallis JF, Martins J, Diniz J, Carreiro Da Costa F. Correlates of urban children's leisure-time physical activity and sedentary behaviors during school days. *Am J Hum Biol* 2014;**26**:407–12.
44. Veitch J, Arundell L, Hume C, Ball K. Children's perceptions of the factors helping them to be "resilient" to sedentary lifestyles. *Health Educ Res* 2013;**28**:692–703.
45. Edwards MJ, Jago R, Sebire SJ, Kesten JM, Pool L, Thompson JL. The influence of friends and siblings on the physical activity and screen viewing behaviours of children aged 5-6 years: a qualitative analysis of parent interviews. *BMJ Open* 2015;**5**: e006593. doi:10.1136/bmjopen-2014-006593.
46. Migueles JH, Cadenas-Sanchez C, Ekelund U, Delisle Nyström C, Mora-Gonzalez J, Löf M, et al. Accelerometer data collection and processing criteria to assess physical activity and other outcomes: a systematic review and practical considerations. *Sports Med* 2017;**47**:1821–45.