Changes in physical activity and sedentary behavior during the transition from elementary to secondary school

Cindy Rutten, Filip Boen, and Jan Seghers

KU Leuven, Department of Kinesiology, Tervuursevest 101, 3001 Leuven, Belgium

ABSTRACT

Background: The purpose of this study was to identify longitudinal changes in physical activity (PA) and sedentary behavior (SB) and to analyze its association with gender and weight status during the transition from elementary to secondary school.

Methods: Flemish children were recruited in 6th grade of elementary school (age = 10.97 ± 0.41) and reassessed two years later (age = $12.96 \pm .40$). Children completed a questionnaire on moderate to vigorous PA and SB and wore pedometers to monitor habitual PA. Longitudinal data from 472 children were analyzed.

Results: A significant decrease was observed in self-reported moderate to vigorous PA (-12.2%), but not in pedometer-determined PA. With respect to SB, a pronounced increase in recreational computer use was found (+3.22 hours/week), particularly in overweight boys (+8.18 hours/week). Finally, a significant increase in time spent on homework was observed in girls (+3.57 hours/week) and normal weight children (+2.83 hours/week).

Conclusions: No longitudinal change in pedometer-determined PA was observed. Nevertheless, the decline in self-reported moderate to vigorous PA suggests that the transition to secondary school induced a change in the contribution of different types of PA. Finally, time spent on homework and recreational computer use increased during the school transition.

INTRODUCTION

Despite the well-documented health benefits of regular physical activity in youth¹, a substantial number of children in Western societies are insufficiently active². Moreover, longitudinal data showed that the level of PA decreases during adolescence³. Possible explanations for this age-related decline in youth PA could be linked to the transition from childhood to early adolescence⁴. This transition is one of the key periods in a person's life where major changes are taking place: biological transformations (puberty), changes in cognition and changes in relationships with peers and family⁵. Furthermore, in most countries this period coincides with the educational transition from elementary to secondary school. For most children, this school transition constitutes a significant life event⁶. It often coincides with changing to a new school environment (e.g., other school location, new classmates and different teachers). In a qualitative study of Canadian children, girls reported that the transition from elementary to secondary school was one of the key reasons for a decrease in PA⁴. In addition, a number of quantitative studies have identified decreasing levels of self-reported PA and objectively measured after-school PA during the transition from elementary to secondary school^{7,8}.

It is important to recognize that being insufficiently physically active (i.e., the absence of health-enhancing PA in everyday life) is not the same thing as being sedentary. Sedentary behaviors (SB) refer to 'activities that do not increase energy expenditure substantially above the resting level and includes activities such as sleeping, sitting, lying down, and watching television, and other forms of screen-based entertainment'⁹. Sedentary pursuits are multi-faceted and can also include motorized transportation, and sitting to read or complete homework. Previous research often revealed only a weak relation between PA and screen-based SB, suggesting that high levels of PA and SB can coexist within the lifestyle of a young person^{10,11}. Therefore, SB has been increasingly studied as a determinant of childhood obesity¹², independently from PA. To prevent obesity, it has been recommended that children and adolescents should limit screen time (i.e., TV, DVDs, video games, or cell phones) to no more than two hours per day^{13,14}. Although prospective studies on SB in youth are rather scarce, an increase in screen-based SB can be expected as children move into adolescence.

During early adolescence a growing focus on peers is apparent⁵. Therefore, it can be expected that children will increase their recreational computer use to communicate with friends (e.g., social media). A study by Gebremariam et al.¹⁵ did report an increase in computer/game use in children from 11 to 13 years old. Finally, an increase in academically relevant SB (i.e., homework) is expected during this period because transferring to secondary school usually involves more demanding homework.

Despite the importance of this transition on behavioral changes, prospective research with a particular focus on the impact of this transition from elementary to secondary school on PA behavior is rather scarce^{16,17}. Moreover, only few prospective studies have combined self-reported and objective measures of PA and have taken into account different forms of SB^{3,10,18}. Therefore, the main purpose of this study is to explore longitudinal changes in PA behavior (i.e., self-reported PA and pedometer-determined) as well as SB (i.e., screen-based and academically relevant SB) during the transition from elementary to secondary school. It was hypothesized that PA levels would decrease during the transition to secondary school and that SB, in particular recreational computer use and academically relevant SB, would increase. More knowledge about changes in health-related behaviors such as PA and SB during this educational transition will assist future PA interventions targeted at this important life event in school-aged youth.

METHODS

Participants recruitment

At baseline, a representative sample of elementary schools in Flanders (N=183 schools) was contacted by phone and resulted in a total sample of 103 elementary schools with 2418 participating 6th grade children (1185 boys and 1233 girls). Schools were randomly selected per province taking into account the number of schools in each province. At follow-up (two years later), all children left elementary school and entered different secondary schools making classroom based administration of questionnaires impossible. Therefore, the children and their parents were contacted at their home address and were asked to participate in the second part of the study. A total of 419 children were

willing to wear a pedometer and to fill in the questionnaire and 98 children were only willing to fill in the questionnaire during the second measurement. Unfortunately, 45 children failed to meet the inclusion criteria (child had to follow classes at the same school as the year before and child had to follow classes at a school located in Flanders, children had to provide a minimum of information) and were excluded. The final sample consisted of 472 Flemish children (212 boys and 260 girls) who were tracked from elementary (6th grade) to secondary school (8th grade). At baseline, mean age of the participants was 10.97 (SD = 0.41); 16.9% of the children had a low socio-economic status and 70.8% a medium or high socio-economic status (12.3% were missing); 91.1% of the children had two Belgian native parents, 4.2% of the children had one Belgian native parent and 3.6% of the children had no Belgian native parents (0.2% were missing); 84.7% of the children had a normal weight status and 9.3% of the children had overweight or were obese (5.9% were missing).

Measures

Socio-economic status: at baseline, both parents were asked to fill in their highest degree of education and their current occupation on the informed consent form. We constructed a single variable on the basis of the education level of both fathers and mothers using the PRINCALS data reduction procedure¹⁹. Finally, parents were divided in three equally-sized groups (low, medium and high socio-economic status).

Pubertal status: pubertal status was measured using the self-reported questionnaire validated by Carskadon & Acebo²⁰. This questionnaire consists of five items rating growth spurt in height, pubic hair, skin change, facial hair growth (boys only), voice change (boys only), breast development (girls only), and menarche (girls only).

Pedometer-determined physical activity: children were asked to wear a pedometer (Yamax SW-200) at the waist for seven consecutive days and daily report the number of steps in their PA diary. Children

were also asked to report the time spent on non-weight-bearing activities such as cycling and activities performed without wearing the pedometer (e.g., swimming, sports activities with no approval to wear pedometer by sports coach). Based on Lubans et al.²¹, 146 steps per minute for boys and 137 steps per minute for girls were added to compensate for those activities that were not captured by the raw pedometer data. The first day of the pedometer data was excluded because of familiarization purposes²² and partial data collection. Data were screened for outliers. Steps lower than 1000 or higher than 40000 per day were truncated (replaced by 1000 and 40000, respectively). Similar to the study of Belton et al.²³ average pedometer counts per day were only calculated when data was available of at least three weekdays and one weekend day. The cut-off points of Duncan et al.²⁴ (at least 13000 steps per day for girls and 16000 steps per day for boys) were applied to determine the proportion of children who meet the PA guideline in terms of steps per day.

Self-reported physical activity: self-reported PA was measured using the validated Physical Activity Questionnaire for older Children (PAQ-C)²⁵. The PAQ-C includes nine items concerning moderate to vigorous PA (MVPA) at school and during leisure time. The mean of all items was calculated to indicate the general level of MVPA. The mean of the items referring to MVPA at school was taken to indicate MVPA levels at school and the mean of the items referring to PA during leisure time was taken to calculate MVPA levels during leisure time.

Sedentary behavior: children were asked to report the time (hours per day) they usually spent in television viewing and recreational computer use. Total screen-based SB was calculated by adding up television time and computer time. The cut-off point of two hours of total screen time per day^{13,14} was used to assess the proportion of children who exceed recommended limits for screen time. Children were also asked to report the time (hours per day) they spent doing homework. Questions had to be answered for a typical day during the week as well as during the weekend. Time spent per week on each SB was calculated by the following formula: (Time weekday x 5) + (Time weekend day x 2).

Overweight: children's height (Seca stadiometer) and weight (Seca calibrated scale) were measured at baseline by a trained researcher using standardized procedure. Body Mass Index (BMI) was calculated (kg/m^2). Overweight (including obesity) was determined by means of international age- and gender-specific BMI cut-off points²⁶.

Procedures

Data were collected in 2009 and 2011 from the end of September until the beginning of December. At baseline, children completed the questionnaire in the classroom under supervision of a trained research assistant. Furthermore, the correct use of the pedometer and the PA diary was explained and children's height and weight were measured. For the questionnaire of the children, informed consent was obtained from the school board, who is the legal guardian during school hours in Flanders. For the use of the pedometer and the measurement of height and weight, informed consent was obtained from the parents and children from the age of 12.

At follow-up, children completed the questionnaire at home. Research assistants visited the children at school during recess. The correct use of the pedometer and the PA diary was explained. Informed consent was obtained from the school board, parents and children from the age of 12. The study was approved by the ethical committee of the KU Leuven.

Statistical analyses

Analyses were performed using SPSS 19.0. Missing values of continuous variables were imputed based on the Expectation Maximization algorithm^{27,28}. The number of missing values in each variable ranged from 1.7% to 25.0%. Drop-out analyses (i.e., chi-square statistics and ANOVA's) were performed to detect differences at baseline between the children who responded and children who dropped out at follow-up. Differences between baseline and follow-up concerning PA and SB were analyzed with repeated measures ANOVA with time (2 categories: baseline and follow-up) as a within-subjects variable, gender (2 categories: boy and girl) and (baseline) weight status (2 categories:

normal weight and overweight/obese) as between-subjects variables, and parental socio-economic status (2 categories: low and medium/high SES) and standardized residual change scores of pubertal development as covariates. Chi-square statistics were applied to analyze the number of children that met the PA recommendations of having at least 13000 steps for girls and 16000 steps for boys²⁴ and the number of children that met the recommendation of having no more than two hours of screen time per day^{13,14} during the transition from elementary to secondary school. The applied significance level was 0.05.

RESULTS

Drop-out analysis

Longitudinal data of 472 children were available (drop-out rate of ~80%). These children had a mean age of 10.97 ($SD = 0.41$) years at baseline and 12.96 ($SD = 0.40$) years at follow-up. Drop-out analyses showed no selective drop-out with respect to PA behavior (average steps per day and self-reported MVPA) and time spent on homework (Table 1). However, significant differences between responders and non-responders were found with respect to gender ($\chi^2 = 3.93$, $p = .047$), weight status ($\chi^2 = 13.51$, $p = .000$), socio-economic status ($\chi^2 = 46.49$, $p = .000$), pubertal status ($F = 15.83$, $p = .000$, $\eta^2 = .008$), and screen-based SB ($F = 47.30$, $p = .000$, $\eta^2 = .020$). In general, non-responders could be characterized as girls, being overweight/obese, being more mature, having a lower socio-economic status and reporting higher levels of screen-based SB at baseline.

Longitudinal changes in physical activity

From baseline to follow-up, no significant change in the average number of steps emerged ($F = 0.56$, $p = .453$, $\eta^2 = .001$) (Table 2). Taking into account the pedometer-based PA guidelines²⁴, 53.8% ($N = 254/472$) and 57.8% ($N = 273/472$) of the pupils did meet the PA recommendation at baseline and follow-up, respectively ($\chi^2 = 74.25$, $p = .000$). With respect to the observed PA trajectories during the transition, 24.0% of the children classified as ‘active’ (i.e., meeting the PA guideline) at baseline ($N =$

61/254) shifted towards the ‘inactive’ (i.e., not meeting PA guideline) group at follow-up while 76.0% of the children (N = 193/254) remained ‘active’ after the transition. From the children classified as ‘inactive’ at baseline, 36.7% (N = 80/218) shifted towards the ‘active’ group at follow-up and 63.3% (N = 138/218) stayed ‘inactive’.

Despite the lack of change in average steps per day, a significant decrease of 12.2% in self-reported MVPA was observed during the transition from elementary to secondary school ($F = 25.82$, $p = .000$, $\eta^2 = .061$). Our results also indicated a time by weight status interaction effect for leisure time PA ($F = 5.64$, $p = .018$, $\eta^2 = .014$). In particular, PA during leisure time decreased more in overweight or obese children (-18.3%) compared with normal weight children (-6.7%).

Longitudinal changes in sedentary behavior

Table 3 shows the results of the repeated measures ANOVA for SB. Differences were found between baseline and follow-up concerning screen-based SB ($F = 14.99$, $p = .000$, $\eta^2 = .036$) (+2.99 hours/week) and recreational computer use ($F = 20.86$, $p = .000$, $\eta^2 = .050$) (+3.22 hours/week). Taking into account the health recommendation for screen-time^{13,14}, only 39.0% (N = 184/472) and 28.6% of the pupils (N = 135/472) did not exceed two hours of screen time a day at baseline and follow-up, respectively ($\chi^2 = 54.58$, $p = .000$). The SB trajectories during the transition showed that half of the pupils (52.2%) who did not reached the screen-based SB guidelines at baseline (N = 96/184) shifted to more than two hours of screen-time a day. By contrast, only 16.3% of the pupils who did not meet the guideline (N = 47/288) shifted towards spending less than two hours a day on screen-based SB. Furthermore, the results indicated a time x gender x weight status interaction effect for recreational computer use ($F = 5.46$, $p = .020$, $\eta^2 = .014$). Boys with normal weight increased their recreational computer use less (+2.19 hours/week) compared with boys with overweight (+8.18 hours/week).

With respect to academically relevant SB the results showed a time x gender effect ($F = 4.56$, $p = .033$, $\eta^2 = .011$) as well as a time x weight status effect ($F = 4.41$, $p = .036$, $\eta^2 = .011$). Girls

increased their time spent on homework more compared with boys (girls: +3.57 hours/week; boys: +1.47 hours/week). Moreover, normal weight children increased their academically relevant SB more (+2.83 hours/week) compared with overweight or obese children (+0.90 hours/week).

DISCUSSION

The aim of the study was to examine longitudinal changes in PA and SB during the transition from elementary to secondary school. As hypothesized, a decrease in self-reported MVPA was observed from baseline to follow-up. By contrast, no significant change in pedometer-determined PA during the transition to secondary school was found. There are several possible explanations for these contradictory findings. First, pedometers assess different aspects of PA compared with self-report questionnaires, such as the PAQ-C. The PAQ-C is intended to measure purposeful MVPA, while pedometers measure habitual PA levels without taking into account intensity. Second, the transition from elementary to secondary school in Flanders often coincides with a change in school organization. For instance, children in secondary schools in Flanders regularly have to move from one classroom to another, at least more often compared with elementary schools. One reason is that in secondary school, some classes are often taught in specifically designed classrooms with subject-related material (e.g., geography, biology), while elementary school children have one general classroom teacher for all subjects and usually stay in the same classroom during the school day. Consequently, it can be assumed that these observed changes in school organization may have contributed to the accumulation of incidental steps per day in secondary school, but not to their purposeful MVPA measured with the self-reported questionnaire.

Furthermore, when children get older, children are becoming more independent. Compared with elementary school, parents of children in secondary school more often allow their children to go to school, the sports club or their friends by themselves²⁹, usually by bicycle. Although cycling as a mode of transport was not explicitly questioned with the self-reported questionnaire, children were asked to report cycling in their PA diary. As cycling is a non-weight bearing activity, the total number

of steps per day were compensated taking into account the self-reported minutes of cycling in children's PA diary. At baseline, children reported an average of 85.88 minutes cycling per week (SD = 76.85) compared with 174.35 minutes at follow-up (SD = 125.23). This reported increase in cycling is consistent with previous research. More specifically, Chillón et al.³⁰ studied the change of transport mode to school from childhood to adolescence and found that the number of Swedish children going to school by bike increased from 12% to 31%. Moreover, a recent study of Cardon et al.³¹ among Flemish children concluded that not only the number of children cycling to school increases but also the duration of time spent cycling to school. Secondary schools are often located further away compared with elementary schools.

The results showed no time by gender interaction concerning PA (i.e., steps per day and self-reported PA) during the transition from elementary to secondary school. In contrast to previous research that showed a more pronounced decline in objectively measured MVPA over 12 months in 10-year old girls compared with 10-year old boys³², we only found a trend towards a gender effect on changes in self-reported leisure-time MVPA ($p = .082$).

Furthermore, we did not find a significant time by weight status interaction effect during the school transition for most PA variables, except for self-reported leisure-time MVPA. A more pronounced decrease in leisure-time MVPA was found in overweight children compared with normal weight children. Nonetheless, a trend towards significance ($p < .10$) was found for time by weight status in steps per day ($p = .064$) and total PA ($p = .076$). A possible reason for only finding a trend toward decreasing in our study may be attributed to the higher drop-out rate in children with overweight/obesity. In particular, only a limited number of overweight/obese children ($n = 40$) participated in this study at follow-up, which probably decreased the power of our study. Previous research did find a more pronounced longitudinal change (i.e., decrease) in PA in children with greater body fat proportions³². Consequently, it is possible that the interaction effects in our study are an underestimation due to a selective drop-out of overweight/obese children.

With respect to SB, a significant longitudinal change (i.e., increase) in total screen time emerged. Taking into account the different types of screen use, the observed increase in screen-based behavior was mainly attributed to an increase in recreational computer use rather than television viewing. From baseline to follow-up, a significant increase in recreational computer use was observed (+3.22 hours/week), particularly in overweight/obese boys (+8.18 hours/week). While a study in a group of 11-13 year old Norwegian children found significant longitudinal changes (i.e., increase) in television viewing during the transition between childhood and adolescence¹⁵, only a non-significant trend toward increasing ($p = .10$) was found in our study. It should be noticed, however, that the average time spent watching television at baseline in our study was already high ($M = 13.06$ hours/week, $SD = 8.61$). Results of the Health Behaviour in School-aged Children (HBSC) study, a cross-national survey of children aged 11–15, showed that there is some variation across countries in television viewing². For example, the proportion of Flemish 11-year old children who watched television more than 2 hours per day (~ 62%) is comparable with children in USA (~ 60%) but higher compared with children in Nordic Europe, such as Norway (~ 50%)². In a study among US children, television viewing did not show longitudinal changes among boys, whereas in girls, a significant decrease (by 2.2 hours/week) was observed during the transition from early- to midadolescence³³. Thus, the lack of significant change (increase) in television viewing in our study could be attributed to a leveling off of television viewing during the studied period and/or shift to time spent on other SB. This latter can be illustrated by the increase in time spent on homework during the transition from elementary to secondary school, in particular in girls (+3.57 hours/week) and in normal weight children (+2.83 hours/week). A study of Kackar et al.³⁴ in US adolescents also indicated that older adolescents (high school students) reported more time spent on homework than younger adolescents (middle school students). However, in contrast to our results, Kackar et al.³⁴ did not find that girls spent more time on homework compared with boys. An explanation for this different result can be attributed to the cross-sectional approach and the older age group (i.e., students already made the transition to secondary school) in the study by Kackar et al.³⁴

The major strengths of this research are the objective measurement of habitual PA by means of pedometers, the combination of measuring both PA and SB, and the longitudinal assessment during an impending life transition. It is a challenging period for tracking children given the development to (early) adolescence involving an educational transition from elementary to secondary school. Consequently, the first and main limitation of our study was the high drop-out rate. It should be noted however that this drop-out rate was inherent to the procedure of this study. More specifically, at baseline schools were asked to participate in the study and the research took mainly place during school hours. At follow-up, children and parents were contacted directly at their home address and children had to fill in the questionnaire at home. This procedure was chosen because, at follow-up, most participating children were not following classes together and we did not want the children to miss classes because of the study. Drop-out analyses revealed that generalizations of the results should be made with caution. The second limitation of this study is the recall bias when using self-reported measures^{35,36}. Recall bias is often a problem in young children. Therefore, it was advised not to use self-reported measures in children younger than 10 years old³⁵. However, in our study sample the average age at baseline was 10.97 (SD = 0.41).

Based on our findings concerning the combined use of self-reported PA and pedometer-determined PA, the transition from elementary to secondary school seems to have induced a change in the contribution of different types of PA towards total weekly activity. More specifically, the observed decrease in self-reported MVPA suggest that children were less likely to perform purposeful PA of moderate to high intensity in secondary school. On the other hand, some school-transition related environmental changes may have induced an increased contribution of incidental (non-purposeful) activities (e.g., transport-related PA), as can be inferred from the absence of longitudinal change in number of steps per day. Therefore, future interventions should focus on MVPA and in particular in on children with overweight. Finally, time spent on homework and recreational computer use increased during the transition to secondary school. Recreational computer use increased predominantly in overweight boys, which should be the main target group in future interventions.

In conclusion, this study highlights the need to maximize MVPA engagement, especially in secondary schools, and the important contribution of incidental PA in total PA, such as active commuting to school.

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ACKNOWLEDGEMENTS

The authors are grateful to all pupils, parents and school principals who collaborated in the study.

Table 1: Drop-out analyses

	Non drop-out	Drop-out	<i>F</i> or χ^2
	Mean (SD) or %	Mean (SD) of %	
Gender			3.93**
Boys	44.9%	50.0%	
Girls	55.1%	50.0%	
Weight status			13.51**
Normal weight	90.1%	82.9%	
Overweight/Obese	9.9%	17.1%	
Social-economic status			46.49**
Low	19.3%	37.2%	
Medium-high	80.7%	62.8%	
Puberty (1-4)	1.71 (.58)	1.85 (.59)	15.83**
Average steps per day	15064.04 (4399.28)	14893.55 (5096.91)	0.36**
PA total (PAQ-C) (1-5)	2.95 (0.57)	2.97 (0.60)	0.40**
PA school (PAQ-C) (1-5)	3.71 (0.74)	3.69 (0.80)	0.25**
PA leisure time (PAQ-C) (1-5)	2.52 (0.66)	2.56 (0.68)	1.24**
Screen-based SB (h/week)	19.59 (12.99)	25.34 (16.77)	47.30**
Television viewing (h/week)	13.04 (8.66)	15.72 (10.37)	26.48**
Computer use (h/week)	6.55 (7.02)	9.62 (9.46)	42.98**
Homework (h/week)	7.94 (5.07)	8.39 (5.35)	2.77**

* $p < 0.05$; ** $p < 0.01$

PA = physical activity; PAQ-C = physical activity questionnaire for older children; SB = sedentary behavior; Computer use = recreational computer use

Table 2: Mean (SD) of physical activity at baseline (6th grade) and follow-up (8th grade) according to gender and weight status at baseline^a

		Baseline	Follow-up	ANOVA	
		Mean (SD)	Mean (SD)	Effect	P-value
Steps per day					
Boys	NW (<i>N</i> =162)	16690.16 (4736.21)	17400.06 (5039.55)	<i>T</i>	.453
	OW (<i>N</i> =17)	16378.73 (5693.97)	16190.53 (6180.32)	<i>TxG</i>	.358
Girls	NW (<i>N</i> =202)	13842.44 (3420.12)	14535.24 (4673.08)	<i>TxW</i>	.064
	OW (<i>N</i> =23)	13711.17 (3178.12)	12523.24 (3701.88)	<i>TxGxW</i>	.529
Total PA (1-5)					
Boys	NW (<i>N</i> =162)	3.09 (0.56)	2.76 (0.51)	<i>T</i>	.000
	OW (<i>N</i> =17)	2.97 (0.56)	2.54 (0.59)	<i>TxG</i>	.136
Girls	NW (<i>N</i> =202)	2.87 (0.49)	2.51 (0.44)	<i>TxW</i>	.076
	OW (<i>N</i> =23)	2.84 (0.53)	2.27 (0.38)	<i>TxGxW</i>	.540
School-related PA (1-5)					
Boys	NW (<i>N</i> =162)	3.91 (0.70)	3.18 (0.65)	<i>T</i>	.000
	OW (<i>N</i> =17)	3.78 (0.67)	3.06 (0.73)	<i>TxG</i>	.951
Girls	NW (<i>N</i> =202)	3.58 (0.66)	2.81 (0.41)	<i>TxW</i>	.537
	OW (<i>N</i> =23)	3.38 (0.68)	2.77 (0.33)	<i>TxGxW</i>	.569
Leisure-time PA (1-5)					
Boys	NW (<i>N</i> =162)	2.62 (0.65)	2.46 (0.65)	<i>T</i>	.002
	OW (<i>N</i> =17)	2.47 (0.70)	2.18 (0.69)	<i>TxG</i>	.082
Girls	NW (<i>N</i> =202)	2.45 (0.57)	2.28 (0.62)	<i>TxW</i>	.018
	OW (<i>N</i> =23)	2.53 (0.59)	1.95 (0.51)	<i>TxGxW</i>	.262

^a social-economic status and standardized residual change score of puberty were included as a covariate; SD = standard deviation; PA = physical activity; NW = normal weight; OW = overweight (including obesity); T = Time; G=Gender; W=Weight status.

Table 3: Mean (SD) of sedentary behavior at baseline (6th grade) and follow-up (8th grade) according to gender and weight status at baseline^a

			Baseline	Follow-up	ANOVA	
			Mean (SD)	Mean (SD)	Effect	P-value
Screen-based SB^b (hours/week)						
Boys	NW (<i>N</i> =162)		21.48 (14.48)	23.76 (12.99)	<i>T</i>	.000
	OW (<i>N</i> =17)		21.91 (12.86)	29.76 (15.23)	<i>TxG</i>	.457
Girls	NW (<i>N</i> =202)		17.72 (11.84)	20.79 (13.60)	<i>TxW</i>	.280
	OW (<i>N</i> =23)		19.28 (10.46)	22.96 (12.48)	<i>TxGxW</i>	.285
Television viewing (hours/week)						
Boys	NW (<i>N</i> =162)		13.09 (8.77)	13.19 (7.11)	<i>T</i>	.100
	OW (<i>N</i> =17)		15.24 (10.21)	14.91 (8.19)	<i>TxG</i>	.540
Girls	NW (<i>N</i> =202)		12.68 (8.59)	12.09 (7.31)	<i>TxW</i>	.749
	OW (<i>N</i> =23)	13.61 (7.48)		14.37 (9.30)	<i>TxGxW</i>	.591
Recreational computer use (hours/week)						
Boys	NW (<i>N</i> =162)		8.39 (8.45)	10.57 (8.26)	<i>T</i>	.000
	OW (<i>N</i> =17)		6.68 (7.75)	14.85 (10.76)	<i>TxG</i>	.061
Girls	NW (<i>N</i> =202)		5.04 (5.47)	8.70 (8.54)	<i>TxW</i>	.155
	OW (<i>N</i> =23)		5.67 (5.51)	8.59 (8.92)	<i>TxGxW</i>	.020
Homework (hours/week)						
Boys	NW (<i>N</i> =162)		7.51 (4.66)	9.19 (4.11)	<i>T</i>	.418
	OW (<i>N</i> =17)		8.18 (5.37)	7.62 (4.18)	<i>TxG</i>	.033
Girls	NW (<i>N</i> =202)		8.35 (5.12)	12.10 (4.97)	<i>TxW</i>	.036
	OW (<i>N</i> =23)		9.28 (6.24)	11.26 (5.43)	<i>TxGxW</i>	.792

^a social-economic status and standardized residual change score of puberty were included as a covariate; ^b television viewing + recreational computer use; SD = standard deviation; NW = normal weight; OW = overweight (including obesity); T = Time; G=Gender; W=Weight status.