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Changes in physical activity and sedentary time in the Finnish Schools on the Move program: a quasi-experimental study

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The aim of the Finnish Schools on the Move program is to create a more active and pleasant school day through physical activity (PA). In this quasi-experimental design, we compared changes in moderate-to-vigorous-intensity physical activity (MVPA) and sedentary time (ST) during the school day and outside school hours for Grades 1–9 over two academic years in four program schools and two reference schools. Altogether 319 girls and boys aged 7–15 participated in the study between 2010 and 2012. MVPA and ST were measured four times over the 1.5-year follow-up period for seven consecutive days, using a hip-worn ActiGraph accelerometer. Linear growth curve modeling was used to examine the effect of the program on MVPA and ST during follow-up. School day MVPA increased ($P = 0.010$) and school day ST decreased ($P = 0.008$) in program primary schools (Grades 1–6) more compared with the reference schools. The effect sizes (Cohen's d) for the difference in change (from the first to the last measurement) were small ($d = 0.18$ and $d = -0.27$, respectively). No differences in the changes of leisure-time or whole-day MVPA and ST between the program and reference schools were observed during follow-up. In conclusion, the changes in school day MVPA and ST did not translate into positive effects across the whole day. More effective and longer promotion actions are needed for positive changes in PA and ST, especially in lower secondary schools and for all daily segments.

Insufficient levels of physical activity (PA) and a sedentary lifestyle can produce global public health issues and the economic burden of non-communicable diseases, i.e., Type 2 diabetes, cardiovascular diseases, and cancer (Lee et al., 2012), often developing already in childhood (Fernhall et al., 2011; Väistö et al., 2014). In addition, PA in childhood and adolescence also relates to improved academic performance (Singh et al., 2012), cognitive functioning (Donnelly et al., 2016), and mental health (Biddle & Asare, 2011). However, many children do not meet the daily recommendation of at least 60 min of moderate-to-vigorous-intensity physical activity (MVPA) and spend a lot of time in sedentary activities (Verloigne et al., 2012). Studies have shown a decline in MVPA and an increase in sedentary time (ST) during childhood and adolescence (Colley et al., 2011; Ortega et al., 2013). Accordingly, 34% and 47% in 11-year-olds and 13% and 22% in 15-year-old Finnish girls and boys, respectively, meet the recommended levels of daily MVPA (Bucksch et al., 2016).

School is an important environment to promote PA due to its potential to reach each age group of children and also the inactive and unfit students. However, effect sizes of school-based interventions for PA have been moderate at best and knowledge on the most effective strategies remains limited (Dobbins et al., 2013). A recent meta-analysis suggested that PA interventions in children ages up to 16 years produced only four additional minutes, on average, of daily MVPA (Metcalf et al., 2012). Moreover, a comparison of regular schools and schools offering increased levels of mandatory physical education in the CHAMPS-study DK showed that children with increased physical education were more active during school hours, but less active during leisure-time; thus, no increase was observed for overall PA during the day (Moller et al., 2014). School interventions that combine multiple elements from educational, environmental, and policy-based approaches appear to be effective in PA promotion for children and adolescents, and effective intervention components seem to be, e.g., providing active schoolyard and equipment, increasing the number and length of physical education lessons, and giving students PA homework (van Sluijs et al., 2007; Kriemler et al., 2011).

The social–ecological model suggests that factors at multiple levels influence health-related behaviors, such as PA (Sallis et al., 2006). Therefore, individual, social, environmental, and policy domains should be considered in the development and implementation of school-based interventions. Recently, the conceptual framework Comprehensive School Physical Activity Program (CSPAP) from the United States has been developed based on high-quality physical education, and physical activity is added before, during, and after school with staff, family, and community engagement playing a vital role in PA promotion (Centers for Disease Control and Prevention, 2013). In addition, a curriculum approach to CSPAP called Health Optimizing Physical Education (HOPE) delivers a whole-school approach and community engagement to PA promotion (Metzler et al., 2013). Both of these multi-component programs aim to enable more students to meet the recommended 60 min of daily MVPA and ensure lifelong PA engagement. This study evaluates the results of the Finnish Schools on the Move program, a national action program to create a more active and pleasant school day through PA in Finnish comprehensive schools (Haapala et al., 2014). Physical activity is not only the goal here but also a tool used to improve other school-related outcomes, such as school atmosphere, support for learning, and student empowerment. An important feature of this program is a bottom-up approach; the participating schools and municipalities apply for funding to implement their own individual plans to increase PA and decrease sedentary time (ST) during the school day. Specific actions are not required from the schools; however, the program supports the schools by disseminating best practices and ideas in national seminars and program webpages and providing opportunities for support from experienced local mentors (Haapala et al., 2014; McMullen et al., 2015).

The aim of this study was to investigate the changes in objectively measured MVPA and ST for Grades 1–9 students over two academic years in a quasi-experimental design in schools involved in the Finnish Schools on the Move program's pilot phase compared with the reference schools. Students' MVPA and ST were analyzed for the school day, leisure-time, and the whole day.

Materials and methods

Study design and participants

The data were collected during the national, ongoing Finnish Schools on the Move program. This action program aims to establish a physically active culture in Finnish comprehensive schools (Tammelin et al., 2012), and it is part of the Finnish Government Programme (Prime Minister's Office, 2015). The program is funded by the Ministry of Education and Culture and organized by the Board of Education, regional state administrative agencies, and other organizations. In spring 2010, the Ministry of Education and Culture launched an application process for school-based physical activity projects to be included and funded in the program. A total of 58 applications from municipalities were received, and the office holders of the ministry granted 21 projects with funding from autumn 2010 onward. During the pilot phase (2010–2012), these 21 regional local projects included 45 schools for approximately 10 000 Grades 1–9 students throughout Finland (Tammelin et al., 2012).

Using a quasi-experimental design, data were collected between 2010 and 2012 from four program schools and two reference schools. Four program schools were selected based on the official funding applications, which included the actions plans to promote physical activity during the school day. Selections were made in a research group meeting, and the selection criteria emphasized variety in geographical location and school levels (both primary and lower secondary schools) and viability, versatility, and comprehensiveness of the project action plans to promote school-based PA. The program schools included two primary schools (A and B) and two lower secondary schools (D and E). One primary school (C) and one lower secondary school (F) from similar areas and school levels as the program schools were invited to act as reference schools, i.e., schools not involved in the program. The study population consisted of 319 girls and boys aged 7–15. An invitation to participate was sent to 303 primary school (Grades 1–6) and 334 lower secondary school (Grades 7–9) students. From the invited sample, 188 (61%) primary school students and 131 (39%) lower secondary school students agreed to participate and were included in the final study sample. The participation rates of the schools varied between 26% and 79% in the first measurement in autumn 2010 (Table 1). The grade levels that participated in the study from each school in the first measurement are presented in Table 1.

Program schools and reference schools

The bottom-up approach of the program enabled the participating schools to plan and implement their own individual plans to make the school day more physically active. The program schools apart from School A had not started their promotion actions at the time of the first measurement. Primary School A from an urban area had already sought for a more physically active school day for several years before the start of the program. They continued to offer promotion actions between 2010 and 2012, for example, two longer recess periods (25 and 40 min) during the school day for both organized and unorganized physical activities as well as provision of adequate equipment for PA and development of school sports facilities, especially those outdoors. Physical activities at recess were developed and organized by a hired project worker with the help of students acting as recess activators (peer instructors). Primary School B from an urban area had a longer recess period (30 min) for PA in the first academic year of the program and changed this providing to two longer recess periods (25 and 40 min) during the second academic year of the program. They also built an outdoor equipment area for recess and after-school use, trained older students to be recess activators for younger students, and educated their staff about children's PA.

Lower secondary School D from an urban area focused on developing its school cycling culture by buying bicycles and

Table 1. Schools and students participating the follow-up study and measurement points for each school

	Primary schools (Grades 1–6)			Lower secondary schools (Grades 7–9)		
	School A	School B	School C*	School D	School E	School F*
Grades included in the follow-up	1–2, 4–5	1–3	2, 4–5	7–8	7–8	7–8
Invited to participate†, *n*	115	59	129	128	81	125
Participants†, *n* (%)	90 (79%)	35 (59%)	63 (49%)	58 (45%)	40 (49%)	33 (26%)
Measurement points						
1st measurement	10/2010	11/2010	11/2010	10/2010	11/2010	2/2011
2nd measurement	3/2011	5/2011	4/2011	3/2011	5/2011	5/2011
3rd measurement	10/2011	11/2011	12/2011	10/2011	11/2011	2/2012
4th measurement	3/2012	5/2012	4/2012	3/2012	5/2012	5/2012

Finnish children are obliged to start school at the age of 7. Therefore, students in Grade 1 are approximately 6–7 years old; in Grade 2, 7–8 years old; in Grade 3, 8–9 years old, in Grade 4, 9–10 years old, in Grade 5, 10–11 years old, in Grade 6, 11–12 years old, in Grade 7, 12–13 years old, in Grade 8, 13–14 years old, and in Grade 9, 14–15 years old.

*Reference school.

†From the first measurement.

helmets for school lessons taught outside the school building, motivating the students to commute to school in a physically active way, encouraging students and staff to engage in muscular training by developing the school gym, and educating both students and staff. Lower secondary School E from a rural area included regular physically active morning assemblies and walks during the school day, whole-school events involving sports and PA, lunch break physical activity led by students, and training of its students to be recess activators.

Reference School C from an urban area and reference School F from a semi-urban area were not involved in the program. Therefore, only PA measurements were conducted at these schools.

Measurements

Accelerometer-assessed physical activity and sedentary time

MVPA and ST were measured using the ActiGraph GT1M and GT3X accelerometers. The vertical axis output of GT1M and GT3X monitors has been confirmed to be similar (Sasaki et al., 2011). ActiGraph sensors have been widely studied and shown to have adequate reproducibility, validity, and feasibility for both children and adolescents (de Vries et al., 2006). During the regular school day, trained researchers and staff distributed the accelerometers face-to-face to the children at the schools, and the children were instructed to wear the accelerometer on the right hip with an elastic band during their waking hours for 7 days, except during water activities. Students were shown how to keep a diary to monitor their school hours, sleeping hours, and the types of activities the accelerometer did not measure (such as cycling, strength training, and swimming). In free-living physical activities, children tend to move in short bursts (Bailey et al., 1995), and thus, a 10-s epoch was chosen for the monitoring.

Measurements were conducted four times at each school between 2010 and 2012, and each school had their measurement day the same month in the autumn and spring (Table 1).

Data reduction

Actilife software (Release 5.0 or later) was used to initialize the accelerometers and download the data. A customized Visual basic macro for Excel software was used for data reduction.

Non-wearing time was calculated as periods of more than 30 min of consecutive zero counts. The accelerometer data for school hours (school day) and outside school hours (leisure-time) were filtered from the whole-day data based on the school hours reported in the student diaries. Wearing time during school hours was required to be 80% of full school day. In addition, 500 min of total wearing time was required for a valid day. All school day, leisure–time, and whole-day PA measures were calculated as daily averages for the students that were meeting both conditions for at least two weekdays. PA during the school day, leisure–time, and the whole day was expressed as average counts per minute (cpm). MVPA and ST during the school day were expressed as minutes per hour (min/h) so as to compare the results of school days of varying lengths. MVPA and ST during leisure-time and the whole day were expressed as minutes per day (min/day) and minutes per hour (min/h, adjusted for wearing time), respectively.

Cutoff points based on Evenson et al. (2008) were used to calculate ST (<100 cpm) and MVPA (>2295 cpm). A 20 000 cpm upper limit was set to avoid any spurious data (Heil et al., 2012).

Anthropometrics

Body weight, body height, and waist circumference were measured using standard procedures during the distribution of accelerometers. Body mass index (BMI) was calculated by dividing the weight in kilograms by the square of height in meters and then used as a measure for body adiposity.

Data analysis

Descriptive statistics for the first measurement in autumn 2010 are presented as mean and standard deviations (Mean ± SD) for continuous variables and as percentages for categorical variables in each program school and reference school. Student's *t*-test and chi-square test were used to investigate the differences in study variables between the program and reference schools at the first measurement point as well as to compare those students with complete data on MVPA (and ST) from all four measurement points with those students with incomplete data.

Linear growth curve modeling was used to examine the effect of the program on the development of MVPA (and ST)

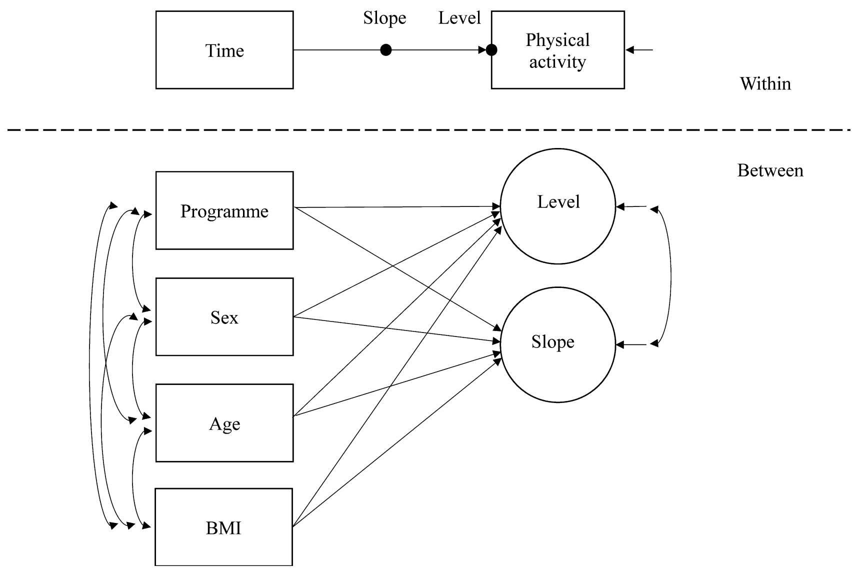

Fig. 1. The path diagram of a linear growth model carried as a multi-level model. BMI, body mass index.

and the level of MVPA (and ST) during the follow-up period (including four measurement points). The path diagram for the hypothesized model is presented in Fig. 1. A multi-level modeling approach was chosen to fit the growth model. The data were converted to long format and the "student" (ID) was considered as a cluster variable (repeated measures nested within the students). The regression coefficient between time and MVPA time (and ST) was specified as a random slope, meaning the coefficient was allowed to vary among students. The level of MVPA (and ST) was also treated as a random intercept. At between-subject level, the effect of the program on the development (slope) and on the level of MVPA (and ST) was estimated and tested for significance. The model at the between-subject level was controlled for potential confounding variables (background variables that differed between the program and the reference schools at the first measurement). In addition, the model was controlled for background variables that related to missingness.

All descriptive statistics were calculated using IBM SPSS Statistics (Version 20.0), and linear growth curve modeling was conducted using the Mplus statistical package (Muthén & Muthén, 2012). The parameters of the models were estimated using the full information maximum likelihood (FIML) estimation method. Missing data were assumed to be missing at random (MAR). MAR means that missingness can be a function of observed covariates and observed outcomes. Unlike the listwise deletion method, FIML uses all available information in a dataset and produces unbiased parameter estimates under MAR assumption. As there were minor violations of normality assumption, maximum likelihood with robust standard errors (MLR) was used. The significance level of the study was set at 0.05. The effect size (Cohen's *d*) was calculated as the difference in the mean changes (from the first measurement to the last measurement) between the program schools and the reference schools divided by a pooled standard deviation at the first measurement. The effect size of $d = 0.2$ was considered small; $d = 0.5$, medium; and $d = 0.8$, large (Cohen, 1992).

Ethics

The study setting for the measurements was approved by the Ethics Committee of the University of Jyväskylä. All measurements were carried out in accordance with the Declaration of Helsinki and Finnish legislation. Written informed parental consent was obtained from all participants, and only those students who provided a completed consent form (signed by both the student and the guardian) on their first measurement day were included as participants in the study.

Results

Missing data

Of the total number of participants (n = 319), 185 students (58%) provided school day PA data at all four measurement points, 75 students (23.5%) at three measurement points, 37 (11.6%) at two measurement points, and 19 (6%) at one time point. Further, three students (0.9%) did not have valid accelerometer-assessed school day PA data at all. The students with all four measurements of school day PA (n = 185) were compared with the students with incomplete data (n = 134). Girls had complete data more often than boys ($\chi^2(1) = 9.92$, $P = 0.003$). The students with complete data were older and had a slightly higher BMI than those students with one or more missing value [$t(317) = -2.00$, $P = 0.046$ and $t(314) = -1.91$, $P = 0.057$, respectively]. No differences in PA measures in the first measurements were observed, except for school day and whole-day ST [$t(284.27) = -2.21$, $P = 0.028$ and $t(301) = -2.89$, $P = 0.004$, respectively]. Students with complete data had more school day ST compared with students with incomplete data.

Characteristics

At the first measurement, primary school students in the reference schools were slightly older, had less total school day and whole-day total PA, and had more school day, leisure-time, and whole-day ST than the primary school students in the program schools. No differences in the first measurement were observed in the measures between the program and reference schools at the lower secondary school level (Table 2). Furthermore, primary school students were more physically active and less sedentary during the school day, leisure-time, and the whole day, and they had lower BMI than lower secondary school students at the first measurement ($P < 0.001$).

At the primary school level, students at School A had higher levels of total PA and MVPA and lower levels of ST, both during the school day ($P < 0.001$) and the whole day ($P = 0.001$) compared with students at the reference school for the first measurement in 2010. Students at School B had less ST both during the school day ($P = 0.009$) and the whole day ($P < 0.001$) compared with the reference school students. At the lower secondary school level, students at School D had higher school day MVPA levels ($P = 0.043$), while students at School E had less total PA ($P = 0.035$) and MVPA ($P = 0.015$) during the school day than those students at the reference school.

Levels and changes in school day, leisure-time, whole-day MVPA, and sedentary time

Because there were differences between the program schools and reference schools in terms of age at the first measurement point, and missing data were dependant on sex and BMI, all the models were controlled for these variables. The path diagram for the hypothesized model is presented in Fig. 1, and the mean values for each measurement point and estimation results of the models are presented in Tables 3 and 4, respectively. The regression coefficient (b) between the program (1 = program, 0 = reference school) and level refers to the difference in the overall level of the outcome variable between the

Table 2. Descriptive statistics at program schools and reference schools at the first measurement (n = 319)

School level	All schools		Program schools		Reference schools		*P*-value
	n	Mean ± SD	*n*	Mean ± SD	*n*	Mean ± SD	
Primary schools	188		125		63		
Sex (boys)	188	50.0%	125	47.6%	63	52.4%	0.643
Age (years)	188	9.3 ± 1.5	125	9.1 ± 1.5	63	9.9 ± 1.2	**< 0.001**
BMI (kg/m^2)	187	17.2 ± 2.6	124	17.1 ± 2.5	63	17.3 ± 2.7	0.622
School day							
Total PA (cpm)	178	615.2 ± 187.9	119	659.8 ± 194.5	59	525.3 ± 136.0	**< 0.001**
MVPA (min/h)	178	5.6 ± 2.3	119	6.1 ± 2.4	59	4.5 ± 1.7	**< 0.001**
ST (min/h)	178	35.8 ± 4.4	119	34.7 ± 4.6	59	37.9 ± 3.2	**< 0.001**
Leisure-time							
Total PA (cpm)	178	582.5 ± 161.2	119	588.0 ± 157.1	59	571.5 ± 170.1	0.523
MVPA (min/day)	178	44.3 ± 17.2	119	43.1 ± 15.9	59	46.7 ± 19.3	0.222
ST (min/h)	178	34.9 ± 4.5	119	34.4 ± 4.4	59	35.9 ± 4.6	**0.029**
Whole-day							
Total PA (cpm)	178	595.2 ± 144.2	119	614.9 ± 139.7	59	555.6 ± 146.2	**0.009**
MVPA (min/day)	178	70.2 ± 22.6	119	71.6 ± 21.6	59	67.3 ± 24.3	0.227
ST (min/h)	178	35.6 ± 4.3	119	34.8 ± 3.7	59	37.2 ± 5.0	**< 0.001**
Lower secondary school	131		98		33		
Sex (boys)	131	44.3%	98	48.0%	33	33.0%	0.143
Age (years)	131	14.0 ± 0.6	98	13.9 ± 0.6	33	14.1 ± 0.6	0.164
BMI (kg/m^2)	129	20.5 ± 3.4	96	20.4 ± 3.0	33	20.7 ± 4.3	0.730
School day							
Total PA (cpm)	125	314.2 ± 90.9	93	311.8 ± 92.4	32	321.1 ± 87.4	0.622
MVPA (min/h)	125	2.8 ± 1.1	93	2.8 ± 1.1	32	2.8 ± 0.9	0.945
ST (min/h)	125	45.5 ± 3.2	93	45.7 ± 3.1	32	44.8 ± 3.5	0.187
Leisure-time							
Total PA (cpm)	125	418.4 ± 143.4	93	414.7 ± 151.8	32	429.2 ± 116.8	0.625
MVPA (min/day)	125	32.8 ± 15.0	93	31.6 ± 14.6	32	36.3 ± 15.8	0.124
ST (min/h)	125	42.4 ± 3.5	93	42.5 ± 3.8	32	42.3 ± 2.6	0.783
Whole-day							
Total PA (cpm)	125	376.8 ± 100.2	93	372.9 ± 102.3	32	388.3 ± 94.7	0.456
MVPA (min/day)	125	48.5 ± 17.0	93	47.4 ± 16.4	32	51.7 ± 18.3	0.223
ST (min/h)	125	43.7 ± 2.8	93	43.7 ± 2.9	32	43.5 ± 2.4	0.632

SD, standard deviation; BMI, body mass index; PA, physical activity; Cpm, counts per minute; ST, sedentary time; MVPA, moderate-to-vigorous-intensity physical activity.

P-value for difference between program and reference schools from Student's *t*-test or chi-square test. Statistically significant values presented in bold ($P < 0.05$).

Table 3. Mean values (± standard deviations) for school day, leisure-time, and whole-day moderate-to-vigorous-intensity physical activity (MVPA) and sedentary time (ST) at each measurement point

Measurement points*	1	2	3	4
Primary schools				
Program schools				
School day MVPA (min/h)	6.1 ± 2.4	5.5 ± 1.8	6.2 ± 2.0	6.3 ± 2.0
School day ST (min/h)	34.7 ± 4.6	36.9 ± 3.3	35.9 ± 3.4	36.6 ± 4.1
Leisure-time MVPA (min/day)	43.1 ± 15.9	48.4 ± 20.3	36.5 ± 15.8	45.5 ± 19.9
Leisure-time ST (min/h)	34.5 ± 4.5	34.7 ± 4.9	36.7 ± 5.8	36.3 ± 5.3
Whole-day MVPA (min/day)	71.8 ± 21.4	73.9 ± 25.1	67.5 ± 20.1	76.6 ± 22.4
Whole-day ST (min/h)	34.8 ± 3.7	35.4 ± 3.8	36.8 ± 4.2	36.6 ± 4.1
Reference school				
School day MVPA (min/h)	4.5 ± 1.7	5.1 ± 2.4	4.3 ± 1.5	4.3 ± 1.8
School day ST (min/h)	37.9 ± 3.2	38.8 ± 4.6	39.9 ± 3.6	40.9 ± 3.3
Leisure-time MVPA (min/day)	47.3 ± 19.0	47.8 ± 21.2	44.2 ± 17.8	45.4 ± 18.2
Leisure-time ST (min/h)	35.8 ± 4.5	35.7 ± 4.6	37.4 ± 4.3	37.9 ± 5.2
Whole-day MVPA (min/day)	68.1 ± 24.0	72.1 ± 27.4	64.3 ± 21.9	66.4 ± 23.5
Whole-day ST (min/h)	37.3 ± 4.9	40.3 ± 9.3	40.9 ± 8.1	40.3 ± 5.0
Lower secondary schools				
Program schools				
School day MVPA (min/h)	2.8 ± 1.1	3.6 ± 1.7	3.2 ± 1.7	3.2 ± 1.3
School day ST (min/h)	45.8 ± 3.1	45.9 ± 3.9	46.8 ± 3.0	47.7 ± 2.7
Leisure-time MVPA (min/day)	31.8 ± 14.5	31.8 ± 18.2	26.7 ± 12.8	29.5 ± 14.9
Leisure-time ST (min/h)	42.3 ± 4.4	41.8 ± 5.2	43.4 ± 4.1	42.6 ± 5.3
Whole-day MVPA (min/day)	47.6 ± 16.4	53.2 ± 22.8	45.5 ± 16.3	48.0 ± 18.1
Whole-day ST (min/h)	43.7 ± 2.9	43.9 ± 3.2	45.3 ± 2.4	45.4 ± 2.7
Reference school				
School day MVPA (min/h)	2.8 ± 0.8	3.3 ± 1.0	2.7 ± 1.4	3.1 ± 1.4
School day ST (min/h)	44.8 ± 3.4	45.6 ± 2.6	46.3 ± 3.7	48.3 ± 2.9
Leisure-time MVPA (min/day)	36.6 ± 15.6	33.9 ± 11.1	36.9 ± 17.0	37.8 ± 20.1
Leisure-time ST (min/h)	42.2 ± 2.6	42.2 ± 3.6	42.4 ± 5.4	42.8 ± 4.1
Whole-day MVPA (min/day)	51.7 ± 17.9	52.8 ± 14.5	51.9 ± 19.4	53.2 ± 23.5
Whole-day ST (min/h)	43.5 ± 2.4	43.6 ± 3.0	44.6 ± 2.9	44.0 ± 3.6

*First measurement 10–11/2010 and 2/2011, second measurement 3–5/2011, third measurement 10–12/2011 and 2/2012, and fourth measurement 3–5/2012.

Table 4. The regression coefficients for the effect of the program on the level and slope of school day, leisure–time, and whole-day moderate-to-vigorous-intensity physical activity (MVPA) and sedentary time (ST)

	Level			Slope		
	b	SE	*P*	*b*	SE	*P*
Primary schools						
School day MVPA (min/h)	1.14	0.28	**< 0.001**	0.27	0.10	**0.010**
School day ST (min/h)	−2.07	0.54	**< 0.001**	−0.52	0.20	**0.008**
Leisure-time MVPA (min/day)	−5.77	2.78	**0.038**	0.13	0.99	0.894
Leisure-time ST (min/h)	0.10	0.57	0.869	0.04	0.26	0.879
Whole-day MVPA (min/day)	1.40	3.57	0.695	1.33	1.16	0.250
Whole-day ST (min/h)	−2.50	0.69	**< 0.001**	−0.19	0.35	0.584
Lower secondary schools						
School day MVPA (min/h)	0.13	0.19	0.481	0.06	0.11	0.561
School day ST (min/h)	1.52	0.55	**0.006**	−0.48	0.26	0.063
Leisure-time MVPA (min/day)	−3.89	2.62	0.137	−1.31	1.48	0.376
Leisure-time ST (min/h)	0.39	0.60	0.518	0.10	0.27	0.709
Whole-day MVPA (min/day)	−2.78	3.18	0.382	−0.65	1.68	0.698
Whole-day ST (min/h)	0.53	0.49	0.285	0.33	0.24	0.162

1 = program school, 0 = reference school. *b* = unstandardized regression coefficient. SE = standard error. The models controlled for sex, age, and body mass index. Statistically significant values presented in bold ($P < 0.05$).

program and the reference school; the regression coefficient between the program and slope refers to the difference in the change that occurred during the follow-up period for the program schools and the reference schools.

In the primary schools, the level of school day MVPA was 1.1 min/h higher ($P < 0.001$), while leisure-time MVPA was 5.8 min/day lower ($P < 0.038$) in program schools compared with reference schools (Table 4, level estimates). The level of school day ST was 2.1 min/h lower ($P < 0.001$) and whole-day ST was 2.5 min/h lower ($P < 0.001$) in program schools compared with reference schools at the primary school level. In the lower secondary schools, there was no difference in the levels of MVPA or ST between the program schools and reference schools, with the exception of school day ST being 1.5 min/h higher ($P = 0.006$) in the program schools compared with reference schools (Table 4).

In the program primary schools, school day MVPA increased ($P = 0.010$) and school day ST decreased ($P = 0.008$) more than in the reference schools during the follow-up period (Table 4, slope estimates). The effect sizes for these differences were small ($d = 0.18$ and $d = -0.27$, respectively). In the lower secondary schools, there were no significant differences between program and reference schools in the change in different PA and ST measures during the follow-up (Table 4).

When the results were analyzed separately for all four program schools, the level of school day MVPA was higher ($P < 0.001$) and school day ST was lower ($P < 0.001$) only in primary School A compared with reference School C (Table 5). However, no significant differences were observed in the change (slope) of school day MVPA ($P = 0.054$) or ST ($P = 0.526$) during the follow-up period for School A and reference School C. School day MVPA increased ($P = 0.016$) and school day ST ($P < 0.001$) and leisure-time MVPA ($P < 0.001$) decreased more in primary School B than in reference School C during the follow-up period. School day ST decreased ($P = 0.039$) more in the lower secondary School D compared with the reference School F during the follow-up period. Leisure-time MVPA and whole-day MVPA decreased more ($P = 0.001$ and $P < 0.001$) in the lower secondary School E compared with the reference School F.

Discussion

The purpose of this study was to investigate the changes in MVPA and ST over two academic years in two primary and two lower secondary schools

Table 5. The regression coefficients for the effect of the program on the level and slope of school day, leisure–time, and whole-day moderate-to-vigorous-intensity physical activity (MVPA) and sedentary time (ST)

Schools	Level			Slope		
	b	SE	*P*	*b*	SE	*P*
Primary schools						
School A						
School day MVPA (min/h)	1.70	0.29	**< 0.001**	0.17	0.11	0.135
School day ST (min/h)	−2.84	0.58	**< 0.001**	−0.15	0.21	0.486
Leisure-time MVPA (min/day)	−4.54	2.87	0.113	0.62	1.05	0.553
Leisure-time ST (min/h)	0.10	0.27	0.717	0.11	0.60	0.717
Whole-day MVPA (min/day)	5.53	3.66	0.131	1.45	1.21	0.231
Whole-day ST (min/h)	−2.50	0.74	**0.001**	−0.22	0.52	0.674
School B						
School day MVPA (min/h)	−0.38	0.40	0.350	0.38	0.16	**0.016**
School day ST (min/h)	−0.45	0.72	0.529	−1.38	0.27	**< 0.001**
Leisure-time MVPA (min/day)	−6.80	1.46	**< 0.001**	−1.92	0.02	**< 0.001**
Leisure-time ST (min/h)	−0.59	0.85	0.488	0.58	0.32	0.073
Whole-day MVPA (min/day)	−8.11	4.86	0.095	−0.16	1.60	0.921
Whole-day ST (min/h)	−2.45	1.29	0.058	−0.14	1.35	0.916
Lower secondary schools						
School D						
School day MVPA (min/h)	0.57	0.23	**0.012**	0.13	0.13	0.327
School day ST (min/h)	1.28	0.61	0.035	−0.56	0.27	**0.036**
Leisure-time MVPA (min/day)	−2.42	2.67	0.364	−1.26	1.58	0.426
Leisure-time ST (min/h)	0.31	0.64	0.628	0.19	0.27	0.499
Whole-day MVPA (min/day)	0.39	3.27	0.904	0.05	1.81	0.978
Whole-day ST (min/h)	0.31	0.50	0.530	0.19	0.18	0.294
School E						
School day MVPA (min/h)	−0.56	0.15	**< 0.001**	−0.05	0.11	0.672
School day ST (min/h)	1.81	0.57	**0.001**	−0.30	0.25	0.227
Leisure-time MVPA (min/day)	−5.55	1.25	**< 0.001**	−1.54	0.47	**0.001**
Leisure-time ST (min/h)	0.40	0.77	0.600	0.30	0.27	0.262
Whole-day MVPA (min/day)	−7.21	6.80	0.289	−1.82	0.19	**< 0.001**
Whole-day ST (min/h)	0.95	0.61	0.118	0.19	0.18	0.313

1 = program school, 0 = reference school. Results analyzed separately for four program schools compared with reference school (primary Schools A and B vs reference School C, and secondary Schools E and F vs reference School G). *b* = unstandardized regression coefficient. SE, standard error. The models controlled for sex, age, and body mass index. Statistically significant values presented in bold ($P < 0.05$).

involved in the Finnish Schools on the Move program's pilot phase and to compare those results with those of reference schools not involved in the program. We found that school day MVPA increased and school day ST decreased more in the program primary schools (Grades 1–6) than in the reference schools; however, no differences in changes were observed in whole-day MVPA or ST between the program and reference schools during the follow-up. In lower secondary schools, no differences between the program and reference schools were observed in changes of PA and ST.

Previous studies have provided evidence that school-based PA interventions have relatively small effects on the PA levels in children and adolescents (Dobbins et al., 2013). Similarly, we found positive, but small, increases in school day MVPA in the program primary schools compared with the reference schools. We also found that ST increased less in the program primary schools than in the reference schools. However, these changes did not translate into positive effects across the day in our study. Thus, our results suggest that students compensated for the increased school day MVPA and decreased ST by decreasing MVPA in their leisure-time. This finding is supported by studies that indicate that children tend to compensate the increased PA levels by diminishing PA afterward. In a Danish study, PA during school hours was increased by additional physical education lessons, but at the same time, children decreased their PA levels after school hours (Moller et al., 2014). Ridgers et al. (2014, 2015) reported similarly that increases in children's PA levels were compensated by decreased PA levels within the same day or the following day. One possible solution to avoid this compensation effect could be a more intense focus on a "whole-school approach" (Institute of Medicine, 2013). Instead of only intervening the school time, possibilities before, during, and after the school day should be embraced and examined from both an environmental and social perspective using the school as the center of distribution. Effective examples of these approaches are the "KISS" study with increased physical education classes and PA homework (Kriemler et al., 2010) and the "Active Living" study which tackles PA and ST issues in the school, transportation to school (neighborhood), and out-of-school activity programs during leisure-time (van Kann et al., 2016).

The Finnish Schools on the Move program—unlike most interventions—relies on a bottom-up approach in which schools and municipalities have the autonomy to plan and implement actions suitable for their particular situations (Haapala et al., 2014). The concept of the program links to the overall Finnish Education Policy by relying on customization, creativity, encouragement of risk-taking and shared responsibility, and trust (Sahlberg, 2011). As suggested by the social–ecological model (Sallis et al., 2006), the program schools in this study applied these possibilities for physical activity promotion by creating both educational and environmental/policy dimensions. In fact, such multi-component approaches have shown encouraging results in improving PA levels among children and adolescents (van Sluijs et al., 2007; Kriemler et al., 2011). In addition, models based on choice and individualization have presented positive results in both elementary (Naylor et al., 2006) and middle school levels (Hoelscher et al., 2016) for student PA levels and program flexibility. The approach considers each school's unique features, such as readiness or knowledge of staff, current facilities and equipment, and existing co-operation with other networks. This aspect also embraces participant ownership in the process at the individual, school, and community levels.

The challenge with this type of setting is possible selection bias, wherein the study population may be drawn from schools that are more inclined to encourage activity and are motivated to enroll in the program. Program guidelines given to the schools were general and mainly concerned reporting to the funding agent and participation in the evaluation by the research center. Evaluation of the program fidelity in the study schools was based on qualitative data gathered from the overall evaluation of the national program (Tammelin et al., 2012). Local contact persons in each school project participated in interviews (1/2011 and 5/2012) and answered surveys (5/2011 and 1/2012) concerning implemented strategies, benefits, facilitators, and barriers, from the perspectives of students, staff, school community/culture, and networks (Tammelin et al., 2012). In conjunction with the notes on discussions and observations from school visits, the program schools in this study initially implemented the majority of their planned actions. Overall, program fidelity in the study schools appeared to be high.

Similarities were observed between the program school actions despite the autonomy of planning, and some of these strategies have shown effectiveness for PA and ST in other studies: modification of school facilities and equipment (van Sluijs et al., 2007; Kriemler et al., 2011), structural changes in the school day (Kriemler et al., 2011), staff and student schooling on PA, and student participation in planning and implementation (Haapala et al., 2014). However, only one primary program school was able to achieve favorable changes in school day MVPA and ST ultimately compensated outside school hours. Reasons for the ineffectiveness of these strategies may lay in, e.g., insufficient intensity or frequency in the delivery, decreases in staff motivation for implementation, or student possibility to compensate for the school day changes during leisure-time (Ridgers et al., 2014). In addition, School A already had higher levels of PA and lower levels of ST at the first measurement compared with the reference school. Therefore, significant changes during the follow-up may have been harder to accomplish. School size might also be an important factor, as the smallest school (School B) in this current study was able to achieve positive changes both in school day MVPA and ST. A smaller number of staff members might make decision-making easier, engage them more in the process, and thus make positive changes in the school culture more likely.

The development of the program to achieve improved effectiveness should focus on the potential of classroom lessons and the increasingly sedentary lifestyle of students. For example, classroom-based activities were few in this study. The majority of the school day is spent on lessons in the classroom, and intervening this setting both environmentally and educationally (e.g., modifying the classroom furniture and equipment, sharing knowledge and ideas with teachers of active teaching/learning methods) could be effective. In addition to PA, enhancement of students' academic achievement by delivering physically active lessons could motivate the teachers to use this approach as it would facilitate the main aim of education, namely, learning (Mullender-Wijnsma et al., 2016). Furthermore, reduction of sedentary behavior during the school day was not targeted in the program schools of this study. Most schools in the pilot phase of the program (2010–2012) concentrated on increasing levels of MVPA which is by no means a poor aim in itself. However, most school days are very sedentary, as seen in this study and previous research (van Stralen et al., 2014), and the possibilities for moving about as intensely as MVPA requires are not many during usual school hours. The possibilities to break up and reduce sedentary time are numerous in the current school environment, and this goal should be visible for schools to improve the well-being of all their students.

The changes in MVPA and ST in the lower secondary school students in this study were small or non-existent. Both in the program and reference schools, PA levels decreased and ST increased, and no differences in changes were observed in either PA or ST. One of the reasons for these results may be found in the culture of the Finnish society. Adolescents are quite independent already in the lower secondary school phase, and the Finnish education and school culture do support this development. However, at the same time, the physical activity levels declined in this age group and, especially steeply so in Finland (Currie et al., 2008; Iannotti et al., 2012). Engaging lower secondary students to be proactive and participate in the planning and implementation process for PA and ST is essential to support their motivation for changing their behavior. In addition, the attenuation of age-related decline in PA could be a reasonable objective for this type of program approach among adolescents. There are some examples of good practices especially from the lower secondary school level, such as providing equipment (Ridgers et al., 2013; Haapala et al., 2014), gender-specific activities for females (Camacho-Minano et al., 2011), organized recess activities, and peer instructors at recess times (Haapala et al., 2014). In addition, active commuting to school have been positively associated with greater MVPA in adolescence (Mendoza et al., 2011) and could potentially be an effective strategy to use for this population.

The strengths of this study include the longitudinal setting in the school environment and the use of objective measurements of PA. The extraction of the data from school day PA and ST within the school curriculum enabled an accurate examination of changes within the school day. Seasonal variation was also controlled by using comparisons with the reference schools, while differences in age and BMI were controlled for in the analyses. The handling of missing data has been described earlier. However, some limitations still have to be considered when interpreting the results of this study. The sample size was relatively small, and participation rates left room for improvement, particularly in the reference schools. There is a possibility that those students who participated in the study may have been the more physically active students, especially in the reference schools, a factor that might have led to selection bias. The objective measurement method is also sensitive to the effects of weather, and even though the geographical differences in the school locations were considered when agreeing on measurement dates, weather conditions could have differed between these schools. The accelerometer assessment might not have been able to capture all types of physical activity performed during the school day and outside school hours, such as cycling, strength training, climbing, skateboarding, and balancing. Some school themes in this study might also have been difficult for the accelerometer as the measurement method to recognize, such as cycling and gym training in School D. The actions to promote PA in the schools were also all different, and this factor also affects the possibility of interpreting causal relationships between certain actions and the changes observed in PA and ST.

School day MVPA increased and school day ST decreased in primary schools involved in Finnish Schools on the Move program when compared with the reference schools. However, these changes did not translate into positive effects across the day, as no differences in changes were observed in whole-day MVPA and ST. No differences in changes were observed in lower secondary schools. Further research should, thus, investigate whether breaking up and reducing sedentary time in the school environment, introducing physically active teaching methods in the classroom, and intervening in all segments of the students' day from the school have the potential to increase the effectiveness of PA and ST promotion strategies, especially in the lower secondary schools. In addition, more information on the features that facilitate the school staff to adhere well to effective promotion components is needed.

Perspectives

The aim of the Finnish Schools on the Move program is to create a more active and pleasant school day through physical activity (PA). An important feature of the program is its bottom-up approach; the participating schools and municipalities apply for funding to implement their own individual plans to increase PA and decrease sedentary time (ST) during the school day (Haapala et al., 2014). This study shows that school day MVPA increased and school day ST decreased in the primary schools involved in Finnish Schools on the Move program compared with the reference schools. However, these changes did not translate into positive effects across the day, as no differences in changes were observed in whole-day MVPA and ST. No differences in changes were observed in the lower secondary schools. More effective and longer interventions are needed, and breaking up and reducing sedentary time in the school environment, introducing physically active teaching methods in the classroom, and intervening in all segments of a student's day from the school could have the potential to increase the effectiveness of PA and ST promotion strategies. Targeting and innovating new strategies to promote PA and ST, especially in the lower secondary schools, are important improvements to consider. A more intense focus and promotion on PA and ST for all segments of the day, such as active commute to school, could be one of these many solutions.

Key words: Education, motor activity, sedentary behavior, children, adolescents, school.

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