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ORIGINAL

Children's segment specific moderate to vigorous physical activity through a school-initiated physical activity program

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background Since less than one-third of 13-year-olds in many Western countries meet the physical activity guidelines, there is a major need to promote physical activity. The aim of this study was to examine children's segment specific moderate to vigorous physical activity (MVPA) through the school-initiated program.

Material/Methods The sample comprised 76 Finnish elementary school children. Accelerometers were used to investigate the patterns of segmented MVPA through 2012-2014. Repeated Measures Analysis was implemented to summarize variability between time and segments of MVPA.

Results The examination of children's MVPA revealed that their total, weekend, and before-school activity were significant predictors for their subsequent activity. Children's MVPA in physical education classes, before- and after-school, and during school breaks decreased through the program. Both girls and boys accumulated the majority of their weekly MVPA during weekdays and out-of-school.

Conclusions The program provedto be effective in order to sustain children's total MVPA levels, although physical education, before- and after-school, and recess MVPA decreased through the program. Out-of-school activities seemed to be more important than in-school activities in relation to children's total MVPA minutes, when they transfer to the higher grades. Attention should be paid to out-of-school, especially weekend, activities.

Key words elementary school, physical education, accelerometer, longitudinal.

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INTRODUCTION

Currently, less than forty percent of children and youth in many Western countries, for instance, in Australia, Canada, Finland, England, and the United States meet the current physical activity guidelines for at least 60 minutes of daily moderate to vigorous physical activity (MVPA) [1, 2]. Since physical activity levels of children are lower than recommended, and physical activity continues to decline with age [1, 3], there is a major need to promote physical activity [4, 5]. To address this, several researchers have advocated that schools should place a higher priority on encouraging young people to engage greater daily physical activity, especially out-of-school [6-8]. Although it is clear that schools alone cannot provide young people with all the physical activity they need [9], previous studies have shown physical activity interventions to be successful in terms of overall physical activity [10-14]. Despite this, it is difficult to construct a reliable picture of children's daily physical activity behavior, since studies have used different devices, measurement protocols, and reported data in different ways [15]. Therefore, it is essential to investigate children's MVPA with greater scrutiny to improve the future school-based interventions for children and youth [6]. The aim of this study was to examine children's accelerometer--determined segments of MVPA through the Sotkamo Physical Activity as Civil Skill Program [16].

Schools offer children a structured environment with formal (e.g. physical education classes, after-school activities) and informal (e.g. recess, active commuting to school) opportunities for physical activity [4]. Although, a great number of school-based interventions have proved to be successful in promoting students' physical activity during school days [17-19], out--of-school [8, 20, 21], active commuting to school [19], and total physical activity [22-28], data focused on objectively measured physical activity during the specific segments of school days and have mainly limited to cross--sectional studies [4, 29-33]. Recently, Brooke et al. investigated changes in time-segment specific physical activity using similar procedures as the ones used in this study [34]. Thereby, the present study is one of the few attempts to monitor changes in children's segmented MVPA in a form of follow-up.

Previous studies have come to different conclusions regarding children's physical activity behavior on weekdays and at weekends, but results have not been consistent [6, 35-39]. For instance, Flohr, Todd and Tudor-Locke reported that boys were more active at weekends than on weekdays, whereas girls were more active on weekdays than at weekends, based on the pedometer data of 12- to 13-year-old U.S. students [6]. In contrast, a large British study of 9-10-year-old children found that daily activity increased from Monday to Friday and was lower at weekends with a similar pattern in girls and boys [39]. Trayers et al. highlighted that based on the accelerometer data for 8-12-year-olds in the UK, boys were more active on weekdays than girls, but at weekends no gender differences were found [38]. According to a cross-sectional Danish study, third-grade children were more active during weekdays than weekends and boys were more active than girls across four weekdays [35]. Similarly, Grade 5 and 6 Finnish children received 22 minutes more physical activity on weekdays than at weekends, although no gender differences were detected [19]. Nader and colleagues

found that 9-year-old children's weekday activity decreased by 38 minutes per year, while weekend activity decreased by 41 minutes per year across the longitudinal study [40]. Finally, the most active children maintained their physical activity levels at weekends, while among less active peers weekend physical activity at all intensities was lower in a cross-sectional study of 10- to 11-year-old English children [41]. The above reviewed findings demonstrate a large variety of physical activity research in children and youth and, even today, changes in detailed segments of children's MVPA have not yet been widely reported.

Many intervention studies have focused on physical education classes to increase children's physical activity levels at school [10-14]. Considering the physical education classes related MVPA levels, English boys aged between 11 and 12 years of age engaged in MVPA for 60% of lesson time compared to 46% for girls, when physical education classes were systematically observed for each gender [42]. In addition, Stratton [43] and McKenzie et al. [44] found that girls' physical education activity participation is generally less frequent and of a lower intensity than boys' activity. A review of forty studies [44] reporting on physical activity during secondary school physical education classes clearly showed that most lessons do not meet the recommendations [46, 47] for achieving 50% of lesson time in MVPA. Another systematic review of school-based interventions revealed that only one study used an objective method (direct observation) in physical education classes [48]. More recently, an increasing number of studies have used accelerometers across the physical education classes [19, 34, 49, 50]. This reinforces the potential for substantial methodological variation to be introduced in the literature regarding physical activity levels in physical education classes.

While school time allocated to physical education is limited, recess time is scheduled for more periods of each day, making it an even more important school environmental factor for the promotion of physical activity [51]. For instance, Finnish elementary school children usually receive 90 minutes of physical education per week [52] in addition to the average of 300 minutes of recess time (30 breaks x at least 10 minutes) per week, and a daily 30-minute lunch break [53]. Typically, Finnish elementary school children spend their recess breaks outdoors, mainly playing ball games, walking, standing or sitting [19]. In a sample of 122 Belgian children, providing game equipment during recess periods was found to be effective in increasing children's physical activity levels [51]. In addition to the recess activities, schools should offer guidance and additional activities for students to increase their physical activity outside of school [7, 8]. For example, using before- or after-school or extra-curricular programs in order to limit the decline in daily physical activity level [6]. The present pro-gram used school physical education as a tool to promote in-school and out-of-school activity across a period of two academic years.

Although schools are attractive settings for physical activity participation [4], less than one-sixth of U.S. schools were providing before- or after-school physical activity programs [54]. In a study of U.S. Grade 8 students, boys were more active than girls during the late afternoon period, except on Sunday [55]. Similarly, Mota et al. highlighted that 8- to 15-year-old girls

showed a higher percentage of time engaged in MVPA during the morning and early afternoon periods, while boys' percentage of time engaged in MVPA was higher at late afternoon and evening periods in a sample of 84 Portuguese children [56]. According to the Adolescent Health and Lifestyle Survey, only one-third of Finnish school-aged children participated in physical activity outside of school at least four times per week [57]. Based on the current Finnish data, more detailed conclusions are restricted, because unstructured before- or after-school activities has not yet fully been investigated in Finland [5].

Gråstén [58] found that self-reported MVPA of 393 Finnish Grade 5 to 9 students sustained at the same level through the Sotkamo Physical Activity as Civil Skill Program [16]. The present study elucidates these findings by investigating the patterns of segmented MVPA among the same children during the particular program 2012-2014. Firstly, the development of children's total and segmented MVPA through the program were examined, assuming that total MVPA were maintainedat the same level [10-14, 58]. Secondly, the percentages of time spent in MVPA for each segment during week-days and weekends were determined. Based on the previously establish relationships, it was expected that children's daily MVPA minutes were higher on weekdays than at weekends [19, 35, 39] and they received more out-of-school than in-school MVPA minutes [56].

MATERIALS AND METHODS

Study Design and Participants

The sample comprised 76 elementary school children (40 girls, 36 boys) at age of 10 to 13 years old (M = 11.43, SD = .70) from two elementary schools from the same school district. All Grade 5 and 6 students (theoretical N = 229) were invited to participate through a direct contact with school principals. Participation in this study was voluntary and no extra credit was awarded for participation. Thirty-seven percent of the children returned the student assent and parental consent and thus were able to participate in the study. Permission to conduct the study was also obtained from the ethical committee of the local university. Only children who provided complete data for at least three days, including one weekend day, were included into the longitudinal analysis. Therefore, the final data consisted of 76 children.

The data was collected through three measurement phases. Children had the procedures explained to them verbally, including a brief overview of possible physical discomfort that could be caused from wearing an accelerometer. They were asked to wear accelerometers for waking hours across a seven-day period. Seventy percent of children participated in two or three phases.

School-initiated Program

The European Union funded Sotkamo Physical Activity as Civil Skill Program (ESF 2012-2014/6) took place in Sotkamo, Northeast-Finland [16]. All children received school-initiated physical activities across the program 2012-2014. The current program included multilevel activities: Task-involving climate support and physical environment modifications. Task-involving climate support

comprised supplementary teacher training and motivational climate support in regular physical education classes. Teachers participated in at least four 90-minute workshops to extend and develop their current teaching practices. The teacher workshops were organized during the academic year 2010-2011 by the project leaders. The workshops were voluntary or in the minority of cases as a part of teacher's collective bargaining agreement of supplementary training. Teachers were informed about the goals, methods and procedures of promotion and subsequent treatment. The workshops and activities had the following features: 1) Task-involving teaching practices; students work together within a small cooperative group structure, students are responsible for setting up equipment, during lesson time students dictate the rate of progression through specific practices, 2) Task orientation support; evaluation emphasizes individual improvement, 3) Improving students personal skills; students choose practices from a range of offered practices with the different skill requirements, more activity and less waiting during physical education classes, and 4) Positive feedback and encouragement; recognition and feedback is based on individual progress. The teachers completed the structured questionnaires regarding self-evaluation on task-involving teaching practices.

Physical activities focused on developing the physical environment of the school and providing equipment. The activities were organized during extended and regular breaks. The students were given a lot of autonomy when selecting activities. The recess activities included the following actions: 1) Long breaks; daily extended break of 30 minutes in addition to the lunch break and regular breaks, 2) Access to fitness hall; students were allowed to use fitness facilities during the extended and regular breaks in order to exercise or play games, 3) Controlled ballgames; students were responsible for set-ting up ballgames and refereeing during extended breaks (i.e., 5 days x 30 minutes x 12 weeks) under the teachers' supervision, 4) Equipment supply; exercise equipment was available to all students during the extended and regular breaks;students were responsible for setting up equipment. The project leaders monitored the school breaks twice a month. Gråstén's dissertation [58] should be consulted for more detailed information regarding the Sotkamo Physical Activity as Civil Skill Program [16].

Measures

Accelerometers were used for the objective assessments of MVPA. Specifically, Actigraph GT3X+ activity monitors were chosen to investigate the patterns of MVPA on a minute-by-minute basis [59]. The monitors were light, small, easy to use and were worn on the waist. The electronic monitors detected the intensity of movements at ten-second intervals and displayed minutes spent in the moderate to vigorous activity zone. For the purpose of this study the manufacturer's protocols were followed to determine minutes as the representation of MVPA score including all activity during school days and out-of-school across two seven-day periods. The cut-off points presented by Freedson, Pober, and Janz were used for the accelerometer-determined MVPA scores [60]. The Actigraph device has been calibrated for young people in laboratory and free-living conditions [61].

The segments of MVPA were (a) weekend (Sat and Sun), (b) before-school (the 60-minute time period prior to school starting time), (c) after-school (the time from the end of the last school lesson 2pm or 3pm to 10pm), (d) physical

education classes (all class time typically five to six hours across the school day including weekly 90-minute of physical education class), (e) long breaks (daily extended break of 30 minutes), and (f) short breaks (daily regular breaks ranged 5 to 15 minutes in duration). The combined values of all segments were used as children's total MVPA scores.

Statistical Analyses

First, normal distribution, outliers, and missing values of the data were analyzed. No modifications due to normality were required. Two single values (before-school and classes variables at T2) were removed from the covariance matrix based on the Mahalanobis distance test ($p < .001$) of standardized values (±3.00) [62]. In addition, not all children provided proper data or were willing to wear the accelerometer for seven days across three phases. Therefore, the longitudinal data included 32% of missing values. Little's MCAR -test ($x^2 = 25.68$, $df = 9$, $p < .01$) and frequencies (gender, grade, measure duration or school) indicated that the missing values were not systematic and did not represent any particular school or group. Hence, the missing values were assumed to be missing at random (MAR) [63].

Several scholars have advocated that imputation is the most practical option to deal with the data of several measurement points, because removing study units with missing values purely may remove a remarkable part of the original data [64-66]. Study units containing missing values were not re-moved, but were imputed using the Multiple Imputation (MI) method [67]. The estimated values were predicted using mean and covariance matrix across 50 imputations for each missing value, and adding normally distributed residual for each new value [65]. Finally, all obtained covariance matrices were used as pooled data. Based on the revision of the original and pooled data, it can be assumed that multiple imputations did not have biased effects on the final results, since the estimates and standard errors were similar before and after imputations.

The descriptive statistics, intercorrelations, and percentages of time spent in MVPA for each segment during weekdays (before- and after-school, physical education classes, long and short recess breaks) and weekends were determined. In order to examine changes through all segments, Repeated Measures Analysis of Variance was implemented to summarize variability between total MVPA phases (T0, T1, T2), segmented MVPA phases (T0, T2), and gender differences [65]. The identical models of repeated measures were implemented for all segments of MVPA. Gender was added into the models as covariate.

Finally, gender differences were analyzed using Chi-square tests and mean difference effects between measurements using the Standardized Mean Difference (SMD) method [68]. It should be noted that the SMD method did not correct for differences in the direction of the scale, since all effect sizes were positive. The missing value analysis was performed using SPSS Version 21.0 [69] and all subsequent analyses including multiple imputation using Mplus Version 6.1 [68].

RESULTS

Descriptive Statistics

Means and standard deviations of segmented MVPA variables were examined (Table 1). Descriptive statistics highlight that both girls and boys received the greatest MVPA minutes during weekends, after-school, and classes. Girls' total MVPA minutes followed the linear pattern of decrease, whereas boys' total MVPA reached the bottom at T1. All segments for both girls and boys showed the negative de-velopment for the minutes spent in MVPA zone. For both girls and boys, the strongest positive correla-tions were found between total MVPA and weekend and after-school activity at T2 (Table 2).

Table 1. Descriptive statistics for the repeated measures of segmented MVPA

		T0		T1		T2	
		Mean (SD)		Mean (SD)		Mean (SD)	
Total	Girls	1037.46	(58.91)	946.91	(53.02)	773.75	(67.08)
	Boys	1187.31	(73.27)	893.73	(63.02)	941.09	(109.36)
Weekend	Girls	243.92	(24.69)	na		162.87	(29.27)
	Boys	253.95	(27.81)	na		209.70	(46.13)
Before-school	Girls	85.69	(7.93)	na		52.88	(3.61)
	Boys	97.91	(10.00)	na		54.97	(5.20)
After-school	Girls	325.10	(28.79)	na		303.44	(25.51)
	Boys	416.39	(34.06)	na		371.19	(41.63)
Classes	Girls	219.48	(12.74)	na		156.35	(11.56)
	Boys	251.80	(15.99)	na		208.28	(22.75)
Long breaks	Girls	67.99	(3.85)	na		32.43	(3.82)
	Boys	66.76	(4.94)	na		42.58	(7.28)
Short breaks	Girls	93.70	(5.91)	na		63.35	(4.82)
	Boys	100.45	(7.82)	na		56.64	(6.93)

na = not available.

Table 2. Summary of intercorrelations for the repeated measures of segmented MVPA

	Total T0	Total T1	Total T2	Week-end T0	Weekend T2	Before school T0	Before school T2	After school T0	After school T2	PE classes T0	PE classes T2	Long breaks T0	Long breaks T2	Short breaks T0	Short breaks T2
Total T0		.539	.341	.776***	.375	.615*	.205	.775***	.366	.661*	-.035	.466	-.019	.380	.168
Total T1	.573		.566	.444	.589	.274	.073	.470	.513	.311	.279	.197	.098	.111	.422
Total T2	.294	.575		.430	.898***	.261	.352	.207	.879**	.056	.726*	.020	.409	.100	.808
Weekend T0	.759***	.537	.418		.491	.456	.118	.410	.406	.319	.039	.273	.029	.180	.328
Weekend T2	.338	.678	.901**	.474		.275	.262	.183	.669	.109	.495	.047	.371	.181	.670
Be-fore-school T0	.361**	-.060	.009	.175	.024		.466*	.316	.305	.471	-.133	.232	-.039	.216	.143

Be-fore-school T2	.009	.050	.353	.004	.310	.350*		-.032	.270	.245	.252	.337	.077	.316	.357
After-school T0	.841***	.595	.168	.481	.237	.089	-.107		.310	.324	.017	.157	-.120	-.002	.157
After-school T2	.374	.539	.896***	.423	.721*	.043	.218	.264		.014	.624	.017	.198	-.034	.659
PE classes T0	.748**	.260	.059	.376	.028	.451	-.025	.501	.168		-.179	.592	.125	.653	.009
PE classes T2	-.017	.241	.806**	.139	.598	-.216	.243	-.065	.671*	-.156*		-.102	.376	-.018	.718**
Long breaks T0	.577	.290	.129	.278	.067	-.096*	.029	.535	.225	.481	.085		-.086	.649**	.006
Long breaks T2	-.107	.022	.449	-.094	.260	.042	.224	-.275	.286	.148	.569	.004		.138	.442
Short breaks T0	.609	.226	.314	.320	.316*	.285	.098	.367	.296	.634*	.173	.612**	.186		.087
Short breaks T2	.051	.276	.788**	.269	.614	-.038	.368	-.141	.617	-.003	.810**	.029	.718**	.159	

***p < .001, **p < .01, *p < .05. Intercorrelations for girls are presented above and intercorrelations for boys below the diagonal.

Table 3. Parameter estimates for the repeated measures analyses of segmented MVPA

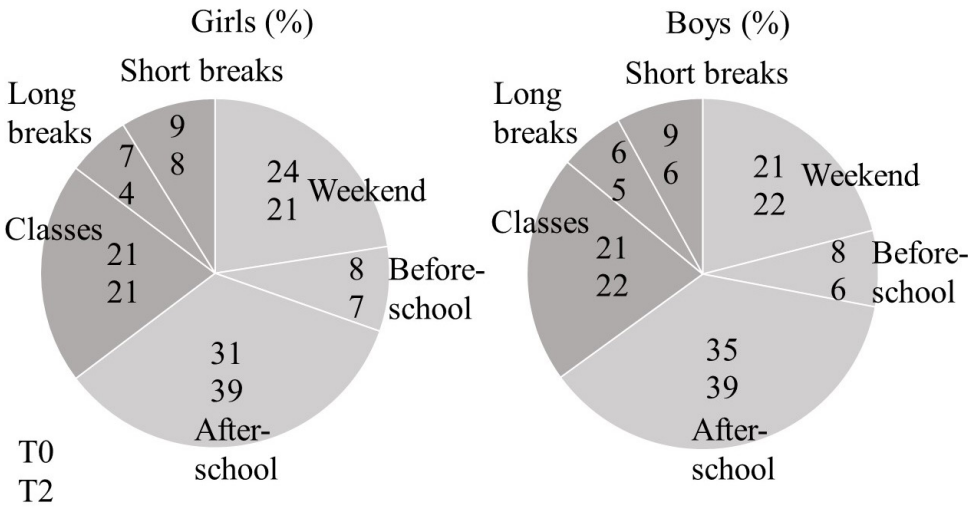
Parameter Estimates	Model Total MVPA (β)	Model Weekend (β)	Model Before-school (β)	Model After-school (β)	Model PE Classes (β)	Model Long breaks (β)
Regression Coefficients						
T0 > T1	.50 (.13)***	na	na	na	na	na
T0 > T2	.09 (.24)	.70 (.21)***	.18 (.06)**	.33 (.18)	-.09 (.18)	-.04 (.18)
T1 > T2	.69 (.23)**	na	na	na	na	na
Correlation Coefficients						
Covariance > T0	.37 (.24)	.03 (.10)	.03 (.03)	.23 (.12)	.08 (.05)	-.00 (.02)
Covariance > T1	-.32 (.18)	na	na	na	na	na
Covariance > T2	.48 (.26)	.10 (.12)	.00 (.02)	.10 (.11)	.14 (.06)*	.03 (.02)
Variances						
Baseline T0	12.26 (2.29)***	1.85 (.37)***	.21 (.04)***	2.86 (.55)***	.56 (.12)***	.05 (.01)***
Covariance	.25 (.04)***	.25 (.04)***	.25 (.04)***	.25 (.04)***	.25 (.04)***	.25 (.04)***
Effect Size	.35 (.68)	.08 (.47)	.82 (.17)***	1.27 (.39)***	2.72 (.68)***	1.80 (.58)**
Fit of the Model	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.20, .30] AIC = 1312.21 BIC = 1344.84	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.07, .22] AIC = 683.99 BIC = 704.97	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.01, .19] AIC = 179.91 BIC = 200.89	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.00, .18] AIC = 701.95 BIC = 722.93	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.00, .17] AIC = 471.78 BIC = 492.75	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.00, .07] AIC = 113.57 BIC = 134.55

***p < .001, **p < .01, *p < .05. Standard errors in parentheses. na = not available.

Percentage of time spent in each segment of MVPA

The percentage of time spent in MVPA for each segment in-school and out--of-school were determined (Figure 1). Children's in-school MVPA segment decreased from 2012 to 2014, accumulating 33% of their weekly total MVPA at T2. The greatest positive changes in the percentages were found in after--school MVPA of girls and boys. However, Chi-square tests revealed no statistically significant mean differences for the percentages of girls and boys or measurements T0 and T2 at p < .05 level. Both girls and boys accumulated the majority of their weekly MVPA minutes on weekdays and out-of-school.

Fig 1. Percentages of time spent in each segment of MVPA at T0 and T2



DISCUSSION

Less than forty percent of children and youth in many countries meet the current physical activity guidelines [1, 2]. Since physical activity levels of children and youth are excessively low [1, 2, 3], there is a major need to promote physical activity at all ages [4, 5]. Many previous school-based interventions have showed to be successful in terms of overall physical activity increase [10-14]. The aim of this study was to analyze children's segmented MVPA through the Sotkamo Physical Activity as Civil Skill Program [16].

The examination of children's MVPA values revealed that their total MVPA, weekend MVPA and before-school MVPA were significant predictors for their MVPA minutes in the particular contexts two years later. Statistically, total MVPA were maintained at the relatively same level, although minutes in both girls and boys decreased across the program. In fact, the trend was similar with the findings of self-reported data collected among a larger sample of the same children [58]. An increase in activities on school days was insufficient to change the pattern of total MVPA to be clearly positive, although the possible decline would have been greater without the provided activities. Despite this, the findings regarding weekend and before-school MVPA were essential, since this latter proposition has not previously been empirically tested among Finnish school children. It seemed that previously established physical activity behavior had a crucial effect on children's subsequent MVPA, especially at weekends and before-school. This finding was similar to the results of Telama et al. [70] and Kirk [71], as they found that physical activity patterns in adulthood were often established during childhood. It is clear that schools alone cannot provide young people with all the physical activity they need [9], since they spent only five to seven hours at school on weekdays. Therefore, schools need to place a higher priority on encouraging children to engage in daily physical activities in addition to regular physical education classes. In order to prevent declining levels of children's total MVPA, attention should also be paid to out-of-school, especially weekend activities. To do that, schools should provide guidance that makes it easy to find out-of-school activities to increase total MVPA minutes. For instance, parents should be informed about the importance for children to actively use neighborhood facilities such as parks and school and kindergarten yards for physical activities in leisure time.

The present data revealed that children's physical education, before- and after-school, and recess MVPA minutes followed the pattern of decrease across the two-year period. These findings were mainly in line with the large SPEEDY study, in which English children's MVPA declined in all time segments, except lesson-time [34]. The difference between the present and the British children regarding physical education class MVPA is difficult to evaluate, because sport facilities in Finland and England are different. For instance, in some schools involved in the English study, fixed sports and play facilities such as climbing frames were provided [34]. However, it should be noted that current total MVPA remainedat the same level across two years of program, although physical education, before- and after-school, and recess MVPA minutes decreased, respectively. This finding is crucial, since previous studies have consistently showed that the level of daily MVPA declines particularly during adolescence as children transfer into adulthood [1, 2, 72]. Therefore, maintained total MVPA levels were encouraging, because many previous school-based interventions have shown to be successful in terms of overall physical activity [10-14]. From this point of view, the Sotkamo Physical Activity as Civil Skill Program [16] proved to be effective.

The major cause of concern arising from the current findings was that children's MVPA during long and short breaks decreased across the program, although recess activities were provided. Ridger-set al. [73] summarized in their systematic review that providing access to school facilities, providing unfixed equipment, and encouraging children to physical activity have apotential to increase physical activity levels during recess periods. Yet only 7% of children's total MVPA was accumulated in recess activities in the end of the current program. In turn, Bailey et al. [29] reported that English children accumulated 26% of their daily MVPA during recess and lunch break activities. It is not appropriate to compare these results as just provided, because recess activities were not standardized, and thus, comparable. In any case, the present finding should be considered as a concern, especially among the most inactive students. An explanation for that may be that children turn to be less active during recess time, when they transfer to higher grades [19]. Typically, Finnish elementary school children spend their recess breaks outdoors, mainly playing ball games, walking, standing or sitting, whereas secondary school students mainly accumulate sedentary time [19]. The decrease in physical education class MVPA was also surprising, since task-involving climate support during classes was provided. On the other hand, to increase MVPA levels through regular physical education classes is challenging [75], because physical education is not only limited to training fundamental movement skills and physical activity [52, 74]. An alternative method to limit the decline in daily physical activity level could be to provide before- or after-school or extra-curricular programs [6]. Before- and after school activities could also be increased, perhaps, through enhanced active transportation to before-school and after-school activities (e.g. sport clubs, hobbies). Almost all Finnish children commute physically actively to school when the distance is one kilometer or less, accumulating mainly light physical activity [19]. Distance to school was also a key predictor of children's active travel, with children living closer being more likely to walk or cycle to school in a large British longitudinal study [34]. Active transportation has not yet been fully investigated in Finland, precisely regarding after-school activities. Nevertheless, parents should encourage their children to walk or bike to after-school

activities instead of driving them by cars [19]. The reasons for a decline in physical education, before- and after-school, and recess time MVPA are not yet clear, but the current findings indicate that this may be an important time to support children in maintaining their activity levels through the certain segments of school days.

Time spent in MVPA for each segment in-school and out-of-school demonstrated that both girls and boys accumulated the majority of their weekly MVPA minutes during the weekdays and out-of-school. Previous studies have come to different conclusions regarding children's physical activity behavior on weekdays and at weekends [6, 19, 35-38]. The findings were similar to the cross-sectional Finnish [19] and Danish [35] studies, when children were more active during weekdays than weekends. Arundellet al. [76] concluded that the importance of the after-school period for Australian children's physical activity increases with age, particularly as children enter adolescence. Similarly, based on the current findings, weekend and out-of-school MVPA minutes could still be increased in order to enhance children's physical activity levels, since out-of-school activities seemed to be more important than in-school activities in relation to their total MVPA across the two-year period.

The strength of this study was the use of accelerometer-determined scores through three measurement points. The results provided important insights into the development of Grade 5 and 6 students physical activity behavior across different segments of daily MVPA. Only one study has used a similar procedure to measure detailed time-segments of children's MVPA behavior across a longitudinal design [34]. The limitations of the study are related to the study design and the sample size. First, the present school-initiated program took place in Finland, and the program may not be replicable in other international school contexts just as in Finland, for instance, considering mandatory recess breaks during school days. Additionally, the number of participants ranged across the study. It is also impossible to know if children with the lowest MVPA levels were not willing to be involved in objec-tive measurements. The longitudinal data is always vulnerable to missing values, because behavior of participants is difficult to predict or control. The current study would benefit if there were more partic-ipants. Despite, the widely accepted MI method was used to complete the data [64-67]. It has to be considered that previous self-reported results of 393 children were similar to these findings [58]. Based on this, it can be assumed that the data was properly completed for the subsequent analysis. For future interventions, children's segmented physical activity could be analyzed using several methods to standardize the practices as accurately as possible. Analysis of sedentary behavior and light activity could provide considerable added value to physical activity. This information could be utilized in various practical applications by providing a clearer understanding of the reasons behind the decline in certain segments of physical activity.

CONCLUSION

The school-initiated Sotkamo Physical Activity as Civil Skill Program indicated to be successful in order to sustain children's total MVPA levels. Although physical education, before- and after-school, and recess MVPA minutes decreased through the two years of the program, all attempts to increase children's

physical activity are valuable, since it seems that previously established physical activity behavior has a crucial effect on children's subsequent activity. Attention should also be paid to out-of-school, especially weekend activities, because children spend only limited time of their waking hours at the school on weekdays. Therefore, out-of-school activities seemed to be more important than in-school activities in relation to their total MVPA minutes during the school years.

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