Journal of Physical Education and Sport ® (JPES), 15(1), Art 15, pp. 88 - 95, 2015
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Children's segment specific light physical activity across two years of school-based program

GRÅSTÉN ARTO
Department of Sport Sciences, University of Jyväskylä, Jyväskylä, FINLAND

Published online: March 25, 2015
(Accepted for publication: March 15, 2015)
DOI:10.7752/jpes.2015.01015;

Abstract:
Making sure that children do not sit down for long periods of time can help them perform better in school and to improve their health. The aim of the study was to examine the patterns of children's light physical activity patterns and gender differences through the Physical Activity as Civil Skill Program 2012-2014. The program was designed to create a new physically active school culture, which required changes in psychological and physical school environment. The sample comprised 76 elementary school children at age of 10 to 13-year-old in Northeast-Finland. The data was collected through three measurement phases from October 2012 to April 2014. Accelerometers were used for the objective assessments of light-intensity physical activity. To improve the reliability of the measures, a hundred and thirty-seven children including the current sample were asked how many days per week and minutes per day they spent in light-intensity activities. The findings highlighted that children's total light physical activity sustained stable through two years of program. However, the segments of before-school, after-school, short break, and girls' class time showed declining patterns across the period. Both girls and boys accumulated the majority of their weekly light physical activity during the weekdays and out-of-school periods compared to weekends and in-school time. The results provided important insights into the development of elementary children's light physical activity across different activity segments. The program seemed to be effective to prohibit declining levels of children's light physical activity. The attention should also be paid on out-of-school, especially after-school and weekend activities, because children spend only limited time of their waking hours at the school on the weekdays.
Key words: elementary school, light physical activity, physical education, accelerometer, longitudinal, program.

Introduction

For a long time, being sufficiently physically active was considered the opposite of having a sedentary lifestyle (Verloigne et al., 2012). Despite, high levels of physical activity are not necessarily equal to low levels of sedentary time, given that children meeting the moderate to vigorous physical activity (MVPA) guidelines (U.S. Department of Health and Human Services, 2008; World Health Organization, 2010) can still be sedentary for many hours per day (Biddle et al., 2004; Owen et al., 2000). Making sure that children do not sit down for long periods of time can help them perform better in school and to improve their health (European Community's Seventh Framework Programme, 2012; Trembley et al., 2014). Many school□based interventions which attempted to increase children's MVPA, focused on adding greater periods of time in active play, sports or other physically active behaviors within school hours (Carrell et al., 2005; Jamner et al., 2004; Simon et al., 2004; Ward, 2011). Less priority has been given to daily light physical activity (LPA), although all activities carried out in a non□sitting posture are of great value to children's well-being and health (European Community's Seventh Framework Programme, 2012; Physical Activity as Civil Skill Program, 2010–2014). Light physical activities, such as walking to school or friends, playing active games, getting the mail, or housework may reduce the thresholds to engage the greater physical activity levels, since school-aged children, for instance, in Australia, Canada, Columbia, Finland, South-Africa, the U.S. (Trembley et al., 2014) and Asian countries (Müller, Khoo & Lambert, 2013) do not engage in sufficient physical activity. Therefore, it is essential to investigate children's LPA with greater scrutiny to improve the future school-based interventions for children and youth.

LPA is defined as any activities with intensity between sedentary behavior and moderate-intensity physical activity, and it involves lower energy expenditure than MVPA, but higher energy expenditure than inactivity (Kwon et al., 2011). The decreasing levels of physical activity are partly due to insufficient participation in leisure time activities. Likewise, an increase in the use of passive modes of transport has also been associated with declining physical activity levels (World Health Organization, 2015). The benefits of MVPA on children's well-being and health is mainly explained by energy expenditure associated with physical

Corresponding Author GRÅSTÉN ARTO, , E-mail: agrasten@jyu.fi

activities (World Health Organization, 2012; 2015). However, the importance and levels of light-intensity activities are largely unknown (Gråstén et al., 2014; Trembley et al., 2014).

Recently, the global matrix of grades comparing children's physical activity levels in 15 countries from Europe, North-America, Africa, and Oceania showed that only a limited number of studies have been carried out in order to examine LPA related activities (Trembley et al., 2014). In fact, only five countries informed that they have enough data to grade "active play" indicator, whereas ten countries graded "active play" indicator as incomplete because of insufficient data or lack of clarity on the benchmark or the definition of active play (Trembley et al., 2014). For instance, data from New Zealand indicated that approximately 75% of children reported participating in active play (Maddison et al., 2010) spending on average 78 minutes per day in free play (Zealand SN, 2012). In contrast, the Finland Adolescent Health and Lifestyle Survey found that only 34% of 12- to 18-year-olds participated in physical activities outside school or sports clubs at least four times per week (Adolescent health and lifestyle survey, 2013). The Australian Lifestyle of Our Kids study showed that children's LPA decreased from age of 11 to 12 years based on the accelerometer scores (Telford et al., 2013). Goran and Reynolds (2005) reported that 9 to 11-years-old boys' LPA decreased, when girls' LPA increased across an eight-week multimedia intervention to increase physical activity implemented in the States. Finally, another intervention conducted in the States, showed that children had a reduction in LPA and increase in MVPA, when families were provided with all equipment necessary to play active video game in the home for the period of 28 weeks (Maloney et al., 2008). Considering the gender differences, no differences were found for LPA between boys and girls in a large Australian sample of school-aged children (Telford et al., 2013). Both girls and boys spent more time in LPA classified intensity outside of school time compared to during school time. In contrast, girls spent less time in LPA in a sample of 10 to 12-years-old children from Belgium, Hungary, Greece, the Netherlands, and Switzerland (Verloigne et al., 2012). Taken together, previous findings reinforce the potential for school-based studies to be introduced in the literature. The present study extends the previous findings by assessing children's segment specific LPA patterns through two years of school-based program. This proposition has not been empirically tested.

The aim of the study was to examine the patterns of children's LPA patterns and gender differences through the Physical Activity as Civil Skill Program 2012–2014. It must be considered that self-reported MVPA of 393 children (Gråstén, 2014) and segment specific MVPA among the same sample as used in the present study (Gråstén, 2015) have recently been reported. The present study elucidates these findings by investigating the patterns of total and segmented LPA among the same children during the particular program. First, the development of segmented LPA through the program was examined, assuming that total LPA increased (Gråstén, 2014; 2015; Telford et al., 2013). Second, the percentages of time spent in LPA for each segment during weekdays and weekends were determined. Based on the previous studies, it was expected that children's spent more time in LPA zone on weekdays and out-of-school than weekends and in-school (Telford et al., 2013).

Method

The sample comprised 76 elementary school children (40 girls, 36 boys) at age of 10 to 13-year-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. Permission to conduct the study was also obtained from the ethical committee of the local university. The data was collected through three measurement phases in October 2012 (T0), April 2013 (T1), and April 2014 (T2). 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. Children, who provided complete data for at least three days, including one weekend day, were included into the analysis. Therefore, the final data consisted of 76 children.

School-based program

The European Union funded Physical Activity as Civil Skill Program (ESF 2012–2014/6) took place in Northeast-Finland in 2010-2014. The program was implemented to prevent long-term effects of inactivity for children's well-being and health. The central assumption of the current program was that children's physical education motivation can be influenced by manipulating the psychological and physical school environment to improve their physical activity levels. Specifically, the program was designed to create a new physically active school culture, which required changes in two different elements, psychological (actions to increase physical activity through manipulation of motivational climate in physical education) and physical environment (providing students increased opportunities for school-day physical activities). The program involved teacher training, since teachers' actions play a crucial role in regards to promoting physical activity in children and youth. Teachers were given supplemental training to increase children's motivation, physical education enjoyment, and physical activities during the school days. The physical environment modifications consisted of improving school facilities, equipment supply, and supporting active transportation to school, as well as after-school activities. All children of the current sample received school-based activities across two-years of program

2012–2014. More detailed descriptions of the program and Finnish physical education curriculum were provided elsewhere (Gråstén, 2014).

Instruments

Accelerometers were used for the objective assessments of LPA. Specifically, Actigraph GT3X+ activity monitors were chosen to investigate the patterns of LPA on a minute-by-minute basis (Actigraph, 2014). The monitors were light, small, and easy to use. The monitors were worn on the waist. The electronic monitors detected the intensity of the 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 LPA 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 (2005) were used for the accelerometer-determined LPA scores. The Actigraph device has been calibrated for young people in laboratory and free-living conditions (Martinez-Gomez et al., 2012). All program participants (N = 229) were not willing to wear the accelerometers. Therefore, to improve the reliability of the measures, a hundred and thirty-seven children including the current sample were asked a simple question (How many days per week and minutes per day, do you usually spend in light-intensity activities?) in April 2013 and April 2014.

The segments of LPA 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 LPA scores. The similar segments have previously been used in MVPA scores based studies (Brooke et al., 2014; Gråstén, 2015).

Data Analysis

First, normal distribution, outliers, and missing values of the data were analyzed. No modifications due to normality were required. Neither outliers were detected based on the Mahalanobis distance test ($p < .001$) of standardized values (± 3.00) (Tabachnick & Fidell, 2007). Some children did not provide proper data or were not willing to wear the accelerometer for seven days across three measurement phases. Therefore, the longitudinal data included missing values. Little's MCAR -test ($\chi^2 = 30.13$, df = 24, $p = .180$) indicated that the missing values were not systematic. Hence, the missing values were assumed to be missing completely at random (MCAR) (Little & Rubin, 2002). 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 (Allison, 2002; Enders, 2010; Widaman, 2006). Study units containing missing values were not removed, but were imputed using the Multiple Imputation (MI) method (Graham, 2009). 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 (Enders, 2010). 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. Correlation coefficients, means, and standard deviations descriptive statistics for each LPA 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 LPA phases (T0, T1, T2), segmented LPA phases (T0, T2), and gender differences (Enders, 2010). The identical models of repeated measures were implemented for all segments of LPA. Gender was added into the models as covariate. Finally, the mean difference effects between measurements were analyzed using Standardized Mean Difference (SMD) method (Muthén & Muthén, 1998-2013). It should be noted that the SMD method did not correct for differences in the direction of the scale, since the effect size values ranged between negative and positive. The missing value analysis was performed using SPSS Version 21.0. (IBM Corporation, 2012) and all subsequent analyses including multiple imputation using Mplus Version 6.1. (Muthén & Muthén, 1998-2013).

Results

Descriptive statistics

Correlation coefficients, means, and standard deviations of the LPA variables were determined (Table 1). Descriptive statistics showed that both girls and boys received the greatest LPA minutes on after-school periods. Based on the mean scores of LPA, girls' total LPA minutes followed the linear pattern of decrease, whereas boys' total LPA minutes reached the bottom at T1. To improve the reliability of the measures, one hundred and thirty-seven children including the current sample were asked how many days per week and minutes per day they spent in light-intensity activities. The responds were similar compared to the accelerometer-determined scores in April 2013 (368 minutes) and April 2014 (338 minutes). All segments for girls and showed the negative development for the minutes spent in LPA zone. In turn, class time LPA minutes

for boys increased across two-years of program. For both girls and boys, the strongest positive correlations were found between total LPA and weekend and after-school activity at T2.

TABLE 1. Descriptive statistics of segment specific light physical activity.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	M	SD
1 Total T0		.61	.51	.70***	.44	.65*	.47	.73***	.39	.65**	.31	.27	.33	.20	.40	437.24	19.93
2 Total T1	.59		.53	.48	.46	.34	-.12*	.55*	.52	.19	.41	.07	.39	.11	.41	416.22	31.35
3 Total T2	.53	.63		.49***	.83	.31*	.38	.27***	.88	.31*	.76	.16	.44	.21	.73	361.34	23.55
4 Weekend T0	.77***	.60	.51		.41	.52*	.21	.23	.54	.21	.23	-.03	.01	-.23	.20	97.87	9.63
5 Weekend T2	.56	.65	.91**	.47		.31	.25	.22	.59	.27	.42	.03	.22	.27	.48	73.57	9.63
6 Before-school T0	.64**	.33	.29	.43*	.35		.51	.16	.24	.52	.05	.35	-.03	.19	.40	46.03	4.01
7 Before-school T2	.52	.01*	.44	.19	.34	.41		.24	.19	.58*	.28	.22	.13	.18	.36	29.33	2.65
8 After-school T0	.74***	.39	.23	.43	.30	.18	.36		.13	.36	.27	.04	.46	.23	.44	146.74	9.81
9 After-school T2	.38	.59	.90**	.52	.77*	.20	.21	.07		.13	.64*	.11	.26	.05	.56	138.31	10.06
10 Classes T0	.68**	.29*	.38	.19	.43	.45	.65*	.45*	.17		.23	.54	.27	.29	.23	98.19	5.05
11 Classes T2	.40	.53	.86*	.39	.68	.14	.47	.19	.70*	.32		.21	.65	.10	.79**	82.86	5.15
12 Long breaks T0	.44	.12	.36	.13	.33	.50	.39	.04	.28	.63	.26		.39	.47	.18	19.11	.81
13 Long breaks T2	.49	.42	.68	.27	.56	.28	.53	.25	.45	.55	.76	.59**		.42	.61*	12.86	1.22
14 Short breaks T0	.33	.20	.34	-.08*	.43	.50	.31	.02	.18	.59	.21	.74**	.57*		.28	29.82	1.22
15 Short breaks T2	.30	.45	.78	.25	.65	.10	.45	.14	.59	.28	.85*	.26	.79**	.35		24.01	1.47
M	409.36	309.39	367.36	97.16	81.29	35.12	28.19	142.33	126.01	93.70	96.44	18.58	12.54	22.63	22.46		
SD	23.35	31.54	39.65	11.38	15.26	4.73	3.48	9.80	16.58	6.65	7.91	1.97	1.97	1.66	2.10		

Note 1. ***p < .001, * p < .05. Note 2. Descriptive statistics for girls are presented above and for boys below the diagonal.

Repeated measures analysis

A repeated measures analysis was implemented in order to examine the changes in segmented LPA minutes through the program (Table 2). All models were saturated and the data fit was perfect, because all the degrees of freedom were used. The repeated measures analysis was carried out using the time points (T0, T1, and T2) as independent variables and specific segments of LPA (total LPA, classes, long and short breaks, before- and after-school, and weekend) as dependent variables.

The models of total LPA yielded a significant interaction for time and total LPA from T0 to T1 ($p < .001$) and T1 to T2 ($p < .05$), accounting 60% and 37% of variance. Additionally, the significant associations were found between time and before-school LPA ($p < .001$), time and long break LPA ($p < .001$), and time and short LPA ($p < .05$), explaining 45%, 53%, and 32% of variance from T0 to T2. In other words, children's total LPA minutes were significant predictors for their LPA minutes one year later. In addition, long break LPA and short break LPA (T0) predicted LPA minutes in the particular contexts two years later (T2). The mean differences between girls and boys were found in total LPA at T1 ($p < .05$) and short break LPA at T0 ($p < .001$). Finally, the significant mean difference effect sizes were found between before-school, after-school, class time, and short break measurements at T0 and T2. To conclude, although before-school, after-school, short break, and girls' class time LPA decreased across the period of two years, total LPA change was not significant.

TABLE 2. Standardized parameter estimates for the repeated measures analysis of segment specific light physical activity.

Parameter Estimates	Total LPA (β)	Weekend LPA (β)	Before-school LPA (β)	After-school LPA (β)	Classes LPA (β)	Long breaks LPA (β)	Short breaks LPA (β)
Regression Coefficients							
T0 > T1	.60 (.10)***	na	na	na	na	na	na
T0 > T2	.28 (.17)	.44 (.12)	.45 (.13)***	.10 (.14)	.26 (.15)	.53 (.10)***	.32 (.14)*
T1 > T2	.37 (19)*	na	na	na	na	na	na
Correlation Coefficients							
Covariance > T0	-.12 (.13)	-.01 (.14)	-.23 (.13)	-.04 (.13)	-.07 (.13)	-.05 (.14)	-.43 (.11)***
Covariance > T1	-.26 (.12)*	na	na	na	na	na	na
Covariance > T2	.20 (.14)	.08 (.16)	.07 (.14)	-.09 (.14)	.24 (.14)	.01 (.15)	.06 (.13)
Intercepts							
T1	-.21 (.40)	na	na	na	na	na	na
T2	.54 (.52)	.44 (.31)	1.15 (.34)***	1.73 (.49)***	1.92 (57)***	-.32 (.45)	3.21 (.36)**
Effect Size	.70 (.67)	.50 (.34)	.73 (.19)***	2.25 (.62)***	2.04 (.56)***	-.51 (.73)	1.70 (.56)**
Fit of the Model	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.21, .32] AIC = 2998.62 BIC = 3031.25	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.08, .22] AIC = 1780.54 BIC = 1801.52	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.00, .11] AIC = 1421.32 BIC = 1442.30	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.00, .02] AIC = 1793.66 BIC = 1814.64	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.04, .20] AIC = 1598.60 BIC = 1619.57	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.08, .22] AIC = 1091.87 BIC = 1112.86	$\chi^2(0) = 0.00$ p > .05 CFI = 1.00 TLI = 1.00 RMSEA = .000 90%, CI = [.12, .26] AIC = 1186.13 BIC = 1207.11

Note 1. ***p < .001, * p < .05. Standard errors in parentheses. na = not available.

Percentages of time spent in each segment of LPA

The percentages of time spent in each segment of LPA were determined (Figure 1). Children's in-school LPA proportion sustained at the same level across 2012 to 2014, accumulating 34% of their weekly total LPA. Girls spent more time in after-school LPA (+4%-points) and boys more time in class LPA (+3%-points) through the program, while the total LPA minutes sustained at the same level. Both girls and boys accumulated the majority of their weekly LPA minutes during the weekdays (78%) and out-of-school (66%) of their total LPA, compared to weekend and in-school LPA.

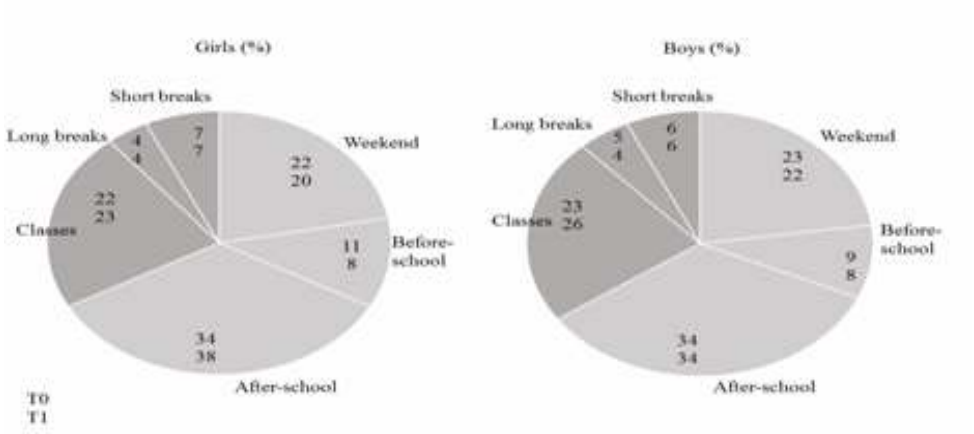

Fig. 1 Percentage of time spent in each segment of LPA at T0 and T2

Discussion

The aim of the study was to examine the segment specific LPA patterns and gender differences through the Physical Activity as Civil Skill Program 2012–2014. The findings highlighted that children's total LPA sustained stable through two years of program. This finding was more or less presumed, since the current program showed to be successful in order to sustain children's objectively measured MVPA levels among the same sample (Gråstén, 2015) and self-reported MVPA among the larger sample of 393 children (Gråstén, 2014). In contrast, a few previously published papers reported that children's LPA decreased across time (Goran & Reynolds, 2005; Maloney et al., 2008; Telford et al., 2013). Therefore, the present findings were encouraging in terms of adopting multilevel school-based activities to reduce inactivity. An explanation for the variation in children's LPA results may be that the present program provided multilevel school-based activities across two school years. Previous studies including LPA measurements, can be considered as short-term interventions. For instance, Goran and Reynolds' intervention (2005) provided multimedia to increase physical activity across the period of eight weeks. Another intervention provided all equipment necessary to play active video game in the home for the period of 28 weeks (Maloney et al., 2008). Additionally, the current program provided multilevel activities, because the central assumption of the current program was that an individual's behavior can be influenced by manipulating the psychological and physical environments (Physical Activity as Civil Skill Program, 2010-2014). Based on the present and previous findings, multilevel interventions have showed to be effective in changing children's physical activity behavior (Murillo et al., 2013; Sallis & Owen, 1999; van Sluijs, McMinn, Griffin, 2007). In turn, Russ and group (2015) reported that there is limited evidence of the effectiveness of multi-component interventions to increase youth total daily physical activity. However, no studies included all components such as quality physical education, physical activity during the school day, before and after school activities, staff wellness, and family engagement. The present program considered all aspects in some way, although some aspects were highlighted.

The results showed also that LPA was a significant predictor for children's total LPA minutes one year later. The similar associations were found between time and before-school, time and long break LPA, and time and short LPA measurements. In addition, the segments of before-school, after-school, short break, and girls' class time LPA showed declining patterns across the period of two years, although in-school physical activities were provided. However, total LPA sustained at the same level. The transition from elementary to secondary school seems to be an important period for LPA engagement. No clear reasons for the variation in segment specific LPA were found without additional information. However, this study was one of the few studies (Telford et al., 2013) to examine the changes in children's LPA across at least two school years. Therefore, the present findings provided new insights into children's LPA participation across school-based program.

Girls received more total LPA minutes after one year of program and LPA minutes during short breaks in the beginning of the measurements. These findings were unexpected, because according to the previously published studies, boys had more LPA than girls (Verloigne et al., 2012). In turn, no differences were found for

LPA scores between boys and girls in a large Australian study (Telford et al., 2013). Light-intensity activities, especially in the form of active play likely varies significantly among countries and in urban and rural areas (Trembley et al., 2014). Similarly, Tammelin and colleagues (2013) found that approximately 90% of Finnish school-aged children reported to commute to school by active transportation, when the distance was less than one kilometer. Precisely, boys commuted to school by bike more often than girls, whereas girls walked more often than boys. The transport mode strongly depended on the distance to the school. In addition, Finnish elementary school-aged boys are more likely to participate in physically active outdoor games during their recess breaks, whereas girls mainly accumulate LPA or sedentary time (Tammelin, Laine, Turpeinen, 2013).

Finally, the percentages of time spent in LPA for each segment during weekdays and weekends were determined. Based on the previous studies, it was expected that children spent more time in LPA zone on weekdays than weekends, and they received more out-of-school than in-school LPA.[21] First, both girls and boys accumulated the majority of their weekly LPA minutes during the weekdays, covering about four-fifth of their total LPA. Additionally, children spent more time in LPA classified intensity out-of-school compared to in-school LPA, accumulating about two-third of their weekly total LPA. It is clear that schools alone cannot provide children with all the physical activity they need (McKenzie, 2004). The attention should also be paid on out-of-school, especially after-school and weekend activities, because children spend only limited time of their waking hours at the school on the weekdays. Taken together, the program including both actions to increase physical activity through manipulation of motivational climate in physical education, and providing students increased opportunities for school-day physical activities indicated to be an effective strategy to prohibit declining levels of children's LPA participation.

The strength of this study was the use of segmented accelerometer-determined scores through three measurement points. The results provided important insights into the development of elementary children's LPA across different activity segments. None of the previous studies has used the similar procedure to measure specific time-segments of children's LPA participation across two years of school-based program. The limitations of the study were related to the study design and sample size. First, the present 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 longitudinal data is always vulnerable to missing values, because behavior of participants is difficult to predict or control. The current study would have benefitted, if there had been more participants. Despite, the widely accepted MI method was used to complete the data (Allison, 2002; Enders, 2010; Widaman, 2006). Additionally, the responds of 137 children including the current sample for the simple question (how many days per week and minutes per day they spent in light-intensity activities) were similar compared to the accelerometer-determined scores. Based on this, it can be assumed that the data was properly completed for the subsequent analysis.

For future interventions, however, the use of larger sample sizes and several techniques to measure physical activity behavior as accurately as possible could provide considerable additional value to physical activity research. This information could be utilized in various practical applications by providing a clearer understanding of the reasons behind the decline in specific segments of LPA at national and international level.

Conclusions

The school-based Sotkamo Physical Activity as Civil Skill Program showed to be successful in order to sustain children's total LPA levels. 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. The attention should also be paid on out-of-school, especially weekend activities, because children spend only limited time of their waking hours at the school on the weekdays. Therefore, out-of-school activities seemed to be more important than in-school activities in relation to their total LPA minutes during the school years.

References

Actigraph (2014). Actilife 6 user's manual. URL (last checked 2 January 2015) http://dl.theactigraph.com

Adolescent Health and Lifestyle Survey (2013). Tampere: University of Tampere, School of Health Sciences.

Allison, P. (2002). Missing data. Thousand Oaks, CA: Sage.

Biddle, S., Gorely, T., Marshall, S., Murdey, I. & Cameron, N. (2004). Physical activity and sedentary behaviours in youth: issues and controversies. The *Journal of the Royal Society for the Promotion of Health, 124*, 29-33.

Brooke, H., Atkin, A., Corder, K., Ekelund, U., van Sluijs, E. (2014). Changes in time-segment specific physical activity between ages 10 and 14 years: A longitudinal observational study. *Journal of Science & Medicine in Sport*. doi:http://dx.doi.org/10.1016/j.jsams.2014.10.003 (in press)

Carrell, A., Clark, R., Peterson, S., Nemeth, B., Sullivan, J. & Allen, D. (2005). Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program. A randomized, controlled study. *Archives of Pediatrics & Adolescent Medicine, 159*, 963-968.

Enders, C. (2010). Applied missing data analysis. New York: The Guilford Press.
European Community's Seventh Framework Programme (2012). A report of the UP4FUN project to reduce sedentary behavior among children, with recommendations for implementing similar projects across Europe. URL (last checked 10 January 2015) http://www.worldobesity.org/site_media/uploads/UP4FUN_Implementation_report.pdf
Freedson, P., Pober, D. & Janz, K. (2005). Calibration of accelerometer output for children. *Medicine & Science in Sports & Exercise, 37*, 523-530. doi:10.1249/01.mss.0000185658.28284
Goran, M. & Reynolds, K. (2005). Interactive multimedia for promoting physical activity (IMPACT) in children. *Obesity Research, 13,* 762-771.
Graham, J. (2009). Missing Data Analysis: Making It Work in the Real World. *Annual Review of Psychology, 60*, 549-576. doi:10.1146/annurev.psych.58.110405.085530
Gråstén, A. (2014). Students' physical activity, physical education enjoyment, and motivational determinants through a three-year school-initiated program. Ph.D. Thesis, Jyväskylä: University of Jyväskylä.
Gråstén, A. (2015). Children's segment specific moderate to vigorous physical activity through a school-initiated physical activity program. Baltic *Journal of Health and Physical Activity*. (submitted)
Gråstén, A., Liukkonen, J., Jaakkola, T. & Tammelin, T. (2014). Finnish report card 2014 on physical activity for children and youth. Jyväskylä, Finland: University of Jyväskylä & LIKES Research Center.
IBM Corporation. (2012). Statistics for Windows Version 21.0. Armonk, NY: IBM Corporation.
Jamner, M., Spruijt-Metz, D., Bassin, S. & Cooper, D. (2004). A controlled evaluation of a school-based intervention to promote physical activity among sedentary adolescent females: project FAB. *Journal of Adolescent Health, 34*, 279-289. doi.org/10.1016/j.jadohealth.2003.06.003
Kwon, S., Janz, K., Burns, T. & Levy, S. (2011). Association between light-intensity physical activity and adiposity in childhood. *Pediatric Exercise Science, 23*, 218-229.
Little, R. & Rubin, D. (2002). Statistical analysis with missing data. New York: Wiley.
Maddison, R., Turley, M., Legge, N. & Mitchelhill, G. (2010). A national survey of children and young people's physical activity and dietary behaviours in New Zealand: 2008/09. Auckland, New Zealand: The University of Auckland.
Maloney, A., Bethea, C., Kelsey, K., Marks, J., Paez, S. & Rosenberg A. et al. (2008). A pilot of a video game (DDR) to promote physical activity and decrease sedentary screen time. *Obesity, 16*, 2074-2080. doi: 10.1038/oby.2008.295
Martinez-Gomez, D., Gomez-Martinez, S., Ruiz, J., Diaz, L., Ortega, F., Widhalm, K. et al. (2012). Objectively-measured and self-reported physical activity and fitness in relation to inflammatory markers in European adolescents: The HELENA Study. *Atherosclerosis, 221*, 260-267. doi:10.1016/j.atherosclerosis.2011.12.032
McKenzie, T., Sallis, J., Prochaska, J., Conway, T., Marshall, S. & Rosengard, P. (2004). Evaluation of a two-year middle-school physical education intervention: M-SPAN. *Medicine & Science in Sports & Exercise, 36*, 1382-1388. doi:10.1249/01.MSS.0000135792.20358.4D
Müller, A., Khoo, S. & Lambert, R. (2013). Review of physical activity prevalence of Asian school-age children and adolescents. *Asian-Pacific Journal of Public Health, 26*, 227-238. doi:10.1177/1010539513481494
Murillo, P., García, B., Generelo, L., Bush, P., Zaragoza, C., Julián, C. & García, G. (2013). Promising school-based strategies and intervention guidelines to increase physical activity of adolescents. *Health Education Research, 28*, 523-538. doi:10.1093/her/cyt040
Muthén L, Muthén B. (1998-2013). Mplus User's Guide. Sixth Edition. Los Angeles, CA: Muthén & Muthén.
Owen, N., Leslie, E., Salmon, J. & Fotheringham, M. (2000). Environmental determinants of physical activity and sedentary behaviour. *Exercise and Sport Science Reviews, 28*, 165-170.
Physical Activity as Civil Skill Program (2010–2014). European Comission: European Social Fund. URL (last checked 5 November 2014) http://www.liikaha.fi/yhteystiedot/liikaha-hanke
Russ, L., Webster, C., Beets, M. & Philips, D. (2015). Systematic review and meta-analysis of multi-component interventions through schools to increase physical activity. *Journal of Physical Activity & Health*. (in press)
Sallis, J. & Owen, N. (1999). Physical Activity and Behavioral Medicine. Thousand Oaks, CA: Sage.
Simon, C., Wagner, A., DiVita, C., Rauscher, E., Klein-Platat, C., Arveiler, D. et al. (2004). Intervention centred on adolescents' physical activity and sedentary behaviour (ICAPS): concept and 6-month results. *International Journal of Obesity, 28*, 96-103. doi:10.1038/sj.ijo.0802812
Tabachnick, B. & Fidell, L. (2007). Using Multivariate Statistics. Boston: Allyn & Bacon.
Tammelin, T., Laine, K. & Turpeinen, S. (2013). Physical actvity of school-aged children. Research Reports on Sport and Health 272. Jyväskylä: LIKES Research Center.
Telford, R., Telford, R., Cunningham, R., Cochrane, T., Davey, R. & Waddington, G. (2013). Longitudinal patterns of physical activity in children aged 8 to 12 years: the LOOK study. *International Journal of Behavioral Nutrition & Physical Activity, 10*. doi:10.1186/1479-5868-10-81

Tremblay, M., Gray, C., Akinroye, K., Harrington, D., Katzmarzyk, P., Lambert, E. et al. (2014). Physical activity of children: A global matrix of grades comparing 15 countries. *Journal of Physical Activity and Health, 11*, 113-125. doi.org/10.1123/jpah.2014-0177

U.S. Department of Health and Human Services (2008). Physical activity guidelines for Americans. URL (last checked 5 November 2014) http://www.health.gov/paguidelines/pdf/paguide.pdf

van Sluijs, E., McMinn, A. & Griffin, S. (2007). Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. *British Medical Journal*;335. doi.org/10.1136/bmj.39320.843947.BE

Verloigne, M., van Lippevelde, W., Maes, L., Yildirim, M., Chinapaw, M., Manios, Y. et al. (2012). Levels of physical activity and sedentary time among 10- to 12-year-old boys and girls across 5 European countries using accelerometers: an observational study within the ENERGY-project. *International Journal of Behavioral Nutrition & Physical Activity, 9*, 1-8. doi: 10.1186/1479-5868-9-34.

Ward, D. (2011). School Policies on Physical Education and Physical Activity. Research Synthesis. Princeton, NJ: Robert Wood Johnson Foundation.

Webber, L., Catellier, D., Lytle, L., Murray, D., Pratt, C., Young, D. et al. (2008). Promoting physical activity in middle school girls: Trial of activity for adolescent girls. *American Journal of Preventive Medicine, 34*, 173-184. doi:10.1016/j.amepre.2007.11.018

Widaman, K. (2006). Missing data: What to do with or without them? *Monographs of the Society for Research in Child Development, 71*, 42-64.

World Health Organization (2010). Global recommendations on physical activity for health. WHO. URL (last checked 5 November 2014) http://whqlibdoc.who.int/publications/2010/9789241599979_eng.pdf

World Health Organization (2015). Physical activity. URL (last checked 15 January 2015) http://www.who.int/topics/physical_activity/en/

Zealand SN (2012). Sport and recreation in the lives of young New Zealanders. Wellington: Sport New Zealand.