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Increasing children's physical activity levels during recess periods in elementary schools: the effects of providing game equipment

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Background: During recess, children can be active on a daily basis, making it an important school environmental factor for the promotion of health-related physical activity. The aim of the present study was to investigate the effects of providing game equipment on children's physical activity levels during morning recess and lunch break in elementary schools. **Methods**: Seven elementary schools were randomly assigned to the intervention group (four schools), including 122 children (75 boys, 47 girls, mean age: 10.8 ± 0.6 years), and to the control group (three schools), including 113 children (46 boys, 67 girls, mean age: 10.9 ± 0.7 years). Children's activity levels were measured before and three months after providing game equipment, using MTI accelerometers. **Results**: During lunch break, children's moderate and vigorous physical activity significantly increased in the intervention group (moderate: from 38 to 50%, vigorous: from 10 to 11%), while it decreased in the control group (moderate: from 44 to 39%, vigorous: from 11 to 5%). At morning recess, providing game equipment was effective in increasing children's moderate physical activity (from 41 to 45%), while it decreased in the control group (from 41 to 34%). **Conclusion**: Providing game equipment during recess periods was found to be effective in increasing children's physical activity levels. This finding suggests that promoting physical activity through game equipment provision during recess periods can contribute to reach the daily activity levels recommended for good health.

Keywords: children, game equipment, health promotion, physical activity, school playtime

Regular physical activity (PA) during childhood and adolescence is associated with improvements in physiological and psychological health.[1,2] Nevertheless, a substantial proportion of young people have lower PA levels than recommended for good health.[3] The 'Health Behaviour in School-aged Children' survey, executed in approximately 1500 11-, 13- and 15-year-olds in each of the 35 participating countries in Europe and America, revealed that only 27% of all girls and 40% of all boys reported PA levels that met the guideline of 'one hour or more of at least moderate intensity activity on five or more days a week'.[4] Furthermore, it is well documented in the literature that PA levels decline from childhood to adolescence and adulthood,[4–7] and tracking studies have revealed that low levels of PA remain stable from adolescence into adulthood.[8] Therefore, the promotion of regular PA among youth is an important public health challenge.

Schools are ideal settings for the promotion of PA since all children can be reached. Schools can provide opportunities to engage in PA during physical education (PE) classes, during recess periods and after school hours (extracurricular activities).[9,10] Furthermore, informing children and their parents about the importance of lifelong PA and the possibilities to be active in the community can contribute to the development of an active and healthy lifestyle.

A lot of intervention studies have focused on PE classes to increase children's PA levels at school.[11–14] However, in most countries PE classes can not provide sufficient activity for children to meet the health-related recommendation of 60 min or more of moderate to vigorous physical activity (MVPA) engagement each day.[3,15–17] While school time allocated to PE is limited, recess is scheduled for more periods each day, making it an important school environmental factor for the promotion of PA. During recess, all children can be active on a daily basis. Furthermore, children are typically engaged in unstructured PA during recess, preparing them for adult activity, which is also typically unstructured.[3] Only a few studies have investigated children's PA levels during recess, revealing that children spent less than 50% of recess time engaged in MVPA.[18–20] Moreover, boys were more active during recess periods than girls.[3,21] In the literature, different opportunities were proposed to increase children's activity levels at recess. Mckenzie *et al.*[18] measured children's activity levels and social prompts (encouragement) for PA during recess in four- and six-year-old children over 2 years. The results indicated that elementary school children were responsive to social prompts for PA from both adults and peers. This implies that training teachers and peers to encourage children to be active during recess can promote PA. Furthermore, playground markings significantly increased five- to seven-year-old children's MVPA engagement during recess periods.[19] Additionally, Connolly *et al.*[22] reported that elementary school children were significantly more active after playground supervisors implemented a games curriculum during recess. Scruggs *et al.*[23] found that structured fitness training breaks provide high-activity levels for both boys and girls. Furthermore, some authors suggested that providing extra game equipment during recess and lunch break may promote high-activity levels.[9,10,21] In most schools, the availability of game equipment during recess is mostly limited to the toys children bring along from home. Providing game equipment for everyone and having teachers encouraging the children to use the equipment may promote children's MVPA engagement during recess. However, in the literature, no study could be located evaluating the effect of providing extra game equipment on children's activity level at recess periods. Since most European elementary schools organize several recess periods per day, stimulating PA during recess

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can contribute to reach the daily activity levels recommended for good health.

The purpose of the present study was to evaluate the effects of providing game equipment on children's activity levels during recess and lunch break. In a controlled pretest–posttest design, children's activity levels were evaluated, using MTI accelerometers.

Methods

Participants and setting

The present study was executed in Belgium. A random sample of seven elementary schools participated in the study. Participating schools were randomly assigned to the intervention group (four schools) and the control group (three schools). The study population included 249 fifth and sixth grade children. During data gathering, three children were excluded from further analyses due to accelerometer malfunctions and 11 due to sickness on the days of measurement. As a result, a sample of 235 children was evaluated. The intervention group consisted of 122 children (seven class groups; 75 boys, 47 girls, mean age: 10.8 ± 0.6 years) and the control group consisted of 113 children (six class groups; 46 boys, 67 girls, mean age: 10.9 ± 0.7 years). All participating schools had a morning recess (mean length: 16 ± 1 min), a lunch break (mean length: 86 ± 6 min) and an afternoon recess (mean length: 13 ± 2 min). The playtime during lunch break was 53 ± 7 min. All schools had comparable playground space and no schools had extra game equipment at baseline. In both groups, no organized activities were conducted at recess or at lunch break during the intervention. The evaluation was considered to be part of the psychological, medical and social counselling provided by the school for which all parents signed a consent form. The study protocol was approved by the Ethics Committee of the University.

Research design

Each class group in the intervention group received a set of game equipment and 'activity cards' including examples of games and activities that can be performed with the equipment. Children were allowed to play outdoors with the equipment during recesses and lunch break. Before providing the game equipment, the different play toys and 'activity cards' were presented to the children of each class group by a research staff member. The teachers were asked to stimulate the children to play with the game equipment. The teachers agreed on rules with the children about the use and the loss or damage of the game equipment to assure its endurance. The teachers were also advised to divide the game equipment into different sets and to exchange those sets regularly to prevent children loosing interest in the equipment. Children were only allowed to play with the equipment of their own class. This made it easier for the teacher to control the equipment and to solve problems (e.g. when children quarrel about the material). The set of game equipment for each class group included two jump ropes, two double dutch ropes, two scoop sets, two flying discs, two catchballs, one poco bal, one plastic bal, two plastic hoops, two super grips, three juggling scarves, six juggling rings, six juggling beanballs, one diabolo, one angel-stick, four spinning plates, two sets of badminton racquets and two sets of oversized beach paddles.

Instruments

Accelerometers were used to measure children's PA levels. The accelerometer has been shown to be a valid, reliable and objective method for monitoring PA in children.[24] In the present study, the MTI Actigraph model 7164 (Manufacturing Technologies Inc., Shalimar, FL) was used. The MTI Actigraph is small ($5 \times 4 \times 1.6$ cm^3), lightweight (37.5 g) and unobtrusive to wear. It is a uniaxial accelerometer designed to measure and record time varying vertical accelerations ranging in magnitude from 0.05 to 2 Gs, with a frequency response ranges from 0.25 to 2.5 Hz. These frequencies were chosen to detect normal human motion and to reject motion from other sources. For the present study, a one-minute sampling interval was used. The one-minute movement counts were downloaded into a personal computer and converted into an Excel file for subsequent analyses. To convert the total activity counts into light (<3 METs), moderate (3.0–5.9 METs) and vigorous intensity activity (>6.0 METs), the accelerometer count cutoffs of Trost *et al.*[7] for children were used. Moderate and vigorous intensity activities were summed to indicate MVPA engagement. To control for the differences in recess length, accelerometer data were expressed in percentages of recess time.

Children's PA levels in both groups were measured before (pretest) and three months after providing the game equipment in the intervention schools (posttest). A research staff member put the accelerometers on in the morning (before the lessons started) and collected them the same day at school after lunch break. The accelerometer data of morning recess and lunch break were used. The accelerometer was worn just above the right hipbone underneath clothes and was held in place by an elastic belt. To prevent the children from increasing their activity level by wearing the accelerometer, they were only informed about the purpose of the measurements after the posttest measurement. Pretest and posttest measurements were organized on days with dry weather conditions, allowing the children to play outdoors.

Data analysis

All data were analysed using SPSS for Windows (12.0). The accelerometer data of morning recess and lunch break were analysed separately because of the different break length, possibly resulting in different play involvement and equipment use. To evaluate the effects of the extra game equipment on children's PA levels during recess periods, repeated measures of ANOVA was used, with time (pretest–posttest) as within-subject factor and group (intervention, control) as between-subject factor. To investigate gender differences, gender was included as a second between-subject factor (time × group × gender). Additionally, to investigate whether intervention effects differed between 'active' (= participating in at least 60 min MVPA per day at baseline) and 'less active' children (= not participating in 60 min MVPA per day at baseline), baseline MVPA engagement was included as a second between-subject factor (time × group × baseline MVPA). The level of statistical significance was set at $P < 0.05$.

Results

Descriptive data of the total sample at pretest showed that the children were engaged in MVPA during 56% (SD 26) of the time at recess and during 51% (SD 24) of the time at lunch break. Boys engaged in MVPA during 68% (SD 21) of the time at recess and during 57% (SD 24) of the time at lunch break. Girls engaged in MVPA during 42% (SD 23) of the time at recess and during 44% (SD 22) of the time at lunch break.

Table 1 presents the percentages of time spent on low, moderate, vigorous and moderate to vigorous intensity PA during morning recess for the intervention and the control group at pretest and posttest measurements. Significant intervention effects were found for the time spent on low ($F = 4.7$, $P < 0.05$), moderate ($F = 10.6$, $P < 0.001$) and moderate to vigorous intensity PA ($F = 6.5$, $P < 0.01$). The time spent on moderate intensity activities increased significantly in the intervention group, while it decreased in the control group. The time

Table 1 Means, standard deviations (SD) and *F*-values of the percentages of time spent on low, moderate, vigorous and moderate to vigorous intensity physical activity during morning recess

Morning recess	Condition	Pretest			Posttest			*F* intervention effect	*F* gender differences
		Total sample (mean % ± SD)	Boys (mean % ± SD)	Girls (mean % ± SD)	Total sample (mean % ± SD)	Boys (mean % ± SD)	Girls (mean % ± SD)		
Low intensity PA	Control	43.20 ± 22.43	33.15 ± 18.90	50.09 ± 22.17	54.54 ± 26.37	35.73 ± 24.17	67.44 ± 19.14	4.73*	12.64**
	Intervention	42.10 ± 28.29	29.63 ± 23.63	61.99 ± 23.44	45.82 ± 24.93	37.25 ± 22.49	59.49 ± 22.57		
Moderate intensity PA	Control	41.10 ± 18.99	44.15 ± 19.02	38.99 ± 18.81	33.90 ± 21.14	43.20 ± 21.52	27.51 ± 18.46	10.60**	6.77**
	Intervention	41.05 ± 22.74	49.53 ± 20.29	27.50 ± 19.82	45.16 ± 21.55	50.66 ± 20.02	36.39 ± 21.17		
Vigorous intensity PA	Control	14.82 ± 17.42	22.55 ± 21.46	9.51 ± 11.42	9.57 ± 17.10	19.97 ± 22.18	2.42 ± 5.75	0.61	2.38
	Intervention	15.53 ± 18.40	20.51 ± 21.01	7.56 ± 8.68	8.24 ± 15.29	11.78 ± 18.20	2.56 ± 5.27		
Moderate to vigorous PA	Control	55.92 ± 22.87	66.71 ± 19.05	48.50 ± 22.43	43.47 ± 27.62	63.17 ± 25.38	29.94 ± 19.95	6.48**	13.31**
	Intervention	56.58 ± 29.37	70.05 ± 23.73	35.07 ± 24.38	53.40 ± 25.63	62.45 ± 22.88	38.95 ± 23.21		

*$P < 0.05$;
**$P < 0.01$

spent on moderate to vigorous intensity activities decreased significantly more in the control group, compared with the intervention group. The time spent on low intensity activities increased significantly more in the control group, compared with the intervention group. No significant intervention effect was found for the time spent on vigorous intensity activities. Significant gender differences (time × group × gender) were found for low ($F = 12.6$, $P < 0.001$), moderate ($F = 6.8$, $P < 0.01$) and moderate to vigorous intensity activities ($F = 13.3$, $P < 0.001$), revealing only intervention effects for girls. In girls, the time spent on moderate intensity activities significantly increased in the intervention group, while it decreased in the control group. In boys, no change was found on moderate intensity activities. In girls, the time spent on low intensity activities decreased in the intervention group, while it increased in the control group. In boys, the time spent on low intensity activities increased in the intervention and in the control group. In girls, the time spent on moderate to vigorous intensity activities significantly increased in the intervention group, while it decreased in the control group. In boys, the time spent on moderate to vigorous intensity activities decreased in both groups. No significant differences between 'active' and 'less active' children were found (time × group × baseline MVPA), revealing that the intervention effect were similar for 'active' and 'less active' children (all $F < 2.4$, ns).

Table 2 presents the percentages of time spent on low, moderate, vigorous and moderate to vigorous intensity activities during lunch break for the intervention and the control group at pretest and posttest measurements. Significant intervention effects were found for low ($F = 50.5$, $P < 0.001$), moderate ($F = 28.3$, $P < 0.001$), vigorous ($F = 13.1$, $P < 0.001$) and moderate to vigorous ($F = 44.2$, $P < 0.001$) intensity activities. The time spent on moderate, vigorous and moderate to vigorous intensity PA increased significantly in the intervention group, while it decreased in the control group. The time spent on low intensity PA decreased in the intervention group and increased in the control group. No significant gender differences (time × group × gender) were found for the accelerometer data during lunch break. No significant differences between 'active' and 'less active' children were found (time × group × baseline MVPA) (all $F < 1.6$, ns).

Discussion

The aim of the present study was to evaluate the effects of providing game equipment on children's PA levels during morning recess and lunch break. At pretest, children in the present study were engaged in MVPA for about half of the time during morning recess (56%) and lunch break (51%). These results were slightly higher than those reported in other studies, using objective measures.[18–20] McKenzie *et al.*[18] found that elementary school children in the United States (mean age 6.6 year) engaged in MVPA during 48% of recess time. In a study by Stratton[19] 5- to 7-year-old British children spent 35–41% of total recess time (including morning, lunch and afternoon playtime) engaged in MVPA. Sleap *et al.*[20] found lower activity levels in 5- to 11-year-old British children during lunch break (46%), but similar MVPA engagement during recess (ranging from 55 to 59%). Furthermore, the results of the present study confirmed previous findings that boys were more active than girls during unstructured recess periods.[18,21,25]

The higher percentages MVPA engagement in the present study is a positive finding. However, since children spent only an average of 50% of recess time engaged in MVPA, increasing children's activity levels during recess periods is an essential and realistic objective. The results of the present study clearly indicated that providing game equipment was effective in increasing children's activity levels during recess and lunch break. During lunch break, the intervention was effective in

Table 2 Means, standard deviations (SD) and *F*-values of the percentages of time spent on low, moderate, vigorous and moderate to vigorous intensity physical activity during lunch break

Lunch break	Condition	Pretest			Posttest			*F* intervention effect	*F* gender differences
		Total sample (mean % ± SD)	Boys (mean % ± SD)	Girls (mean % ± SD)	Total sample (mean % ± SD)	Boys (mean % ± SD)	Girls (mean % ± SD)		
Low intensity PA	Control	43.21 ± 22.36	40.66 ± 22.28	44.96 ± 22.40	53.81 ± 21.28	45.48 ± 23.78	59.53 ± 17.36	50.50	2.39
	Intervention	50.55 ± 23.46	41.95 ± 22.08	64.25 ± 18.73	37.81 ± 20.46	29.44 ± 17.18	51.15 ± 18.17		
Moderate intensity PA	Control	44.03 ± 18.45	41.61 ± 18.77	45.69 ± 18.17	39.29 ± 17.82	44.39 ± 18.43	35.78 ± 16.63	28.34	2.24
	Intervention	38.19 ± 18.67	42.80 ± 17.57	30.81 ± 18.17	49.56 ± 17.68	55.54 ± 16.08	39.99 ± 15.94		
Vigorous intensity PA	Control	10.90 ± 14.14	15.24 ± 17.06	7.91 ± 10.88	5.46 ± 8.76	9.65 ± 11.29	2.57 ± 4.76	13.09	0.53
	Intervention	9.67 ± 12.43	14.05 ± 13.94	2.67 ± 3.47	11.17 ± 14.92	14.35 ± 17.12	6.08 ± 8.42		
Moderate to vigorous	Control	54.93 ± 23.89	56.86 ± 24.69	53.60 ± 23.41	44.74 ± 21.89	54.05 ± 23.85	38.35 ± 17.97	44.23	2.91
PA	Intervention	47.86 ± 24.43	56.85 ± 22.83	33.49 ± 19.71	60.72 ± 21.95	69.89 ± 18.08	46.07 ± 19.62		

*$P < 0.01$

increasing the proportion of time children engaged in MVPA by increasing the time spent on moderate and high intensity activities and by decreasing the time spent on low intensity activities. The mean proportion of MVPA engagement increased with 13% in the intervention group (from 48 to 61%), while it decreased with 10% in the control group (from 55 to 45%). At recess, providing game equipment was effective in increasing children's moderate intensity activities and reducing the decrease in the time spent on moderate to vigorous intensity activities. No effects were found on vigorous intensity activities. As no other studies evaluated the effect of providing game equipment on children's activity levels during recess periods, the present results cannot be compared with other studies.

The stronger intervention effects during lunch break, compared with the morning recess, may be due to the length of the lunch break. The longer duration of lunch breaks may enable the children to organize and to play complete games with the equipment resulting in higher proportions of active time. However, more research is needed to investigate the effect of the duration of recess periods when game equipment is provided.

In both recess periods, the game equipment increased especially children's moderate intensity activities, while children's vigorous PA only slightly increased during lunch break (1.5%). This could be explained by the nature of the chosen game equipment, stimulating moderate intensity activities (e.g. flying discs, angle-stick, juggling material, etc.). Other game equipment may be needed to increase children's vigorous PA engagement.

According to the present study and the literature, girls are less active than boys during recess periods.[21,25] Therefore it is a challenge for schools to promote PA among both boys and girls. During lunch break, the intervention was as effective in boys as in girls, suggesting that the intervention suited both genders. At morning recess, providing game equipment was effective in girls, but not in boys. A possible explanation could be that boys were already very active at pretest, making it difficult to find significant improvements. In addition, the game equipment in the present study may mainly respond to girls' interests, which can also explain this finding. Furthermore, the results of the present study indicated that providing game equipment was as effective in 'active' as in 'less active' children during morning recess and lunch break.

A drawback of the present study was the quasi-experimental design of the study. Another limitation of the study was that the influence of teacher's encouragement to be active with the game equipment was not investigated. Since children seem to be responsive to encouragement for PA from adults,[18] further research is needed to explore the role of teacher encouragement in using the game equipment. Further research should also examine the effect of increased activity levels at school on children's activity levels at home since it is suggested in the literature that children compensate increased activity levels at school by decreasing their activity levels at home.[26] On the other hand, Dale *et al.*[27] indicated that children did not compensate for a sedentary school day by increasing their activity levels after school, emphasizing the importance of providing opportunities to be active at school.

Since all children can be active on a daily basis during recess, recess periods are important opportunities to promote PA at school. The results of the present study demonstrated that providing game equipment can increase children's activity levels during recess periods. To our knowledge, this is the first demonstration that providing game equipment can be effective in increasing children's PA levels during recess periods. Since a lot of European children are less active than recommended for good health, providing game equipment during recesses and lunch breaks are an easy way to improve children's physical activity levels. Additionally, schools should also maximize children's activity levels during PE classes and after school hours (extracurricular activities) and promote lifelong PA

participation at home. Evaluating the effects of providing game equipment over longer time periods is recommended.

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Key points

- A lot of young people have lower activity levels than recommended for good health.
- Recess periods are an important school environmental factor for the promotion of health-related physical activity in elementary school children.
- In the present study, the effect of providing game equipment during recess periods on children's activity levels was evaluated.
- Game equipment provision significantly increased children's activity levels during morning recess and lunch break.
- Providing game equipment during recess periods is recommended from a public health perspective.

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