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Original Article

Promoting physical activity at the school playground: a quasi-experimental intervention study

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ABSTRACT

In looking for new strategies to promote physical activity (PA), the purpose of this study was to determine whether providing equipment, playground markings, and a physical education (PE)-based intervention effectively increases PA levels during school recess. A total of 223 children (mean age = 7.10 years ± 0.6; 45.3% female) from three schools participated in this study in 2012. In the first intervention school (G1; n = 75) six previous PE classes teaching games for recess were performed and playground markings and game equipment were provided. In the second intervention school (G2; n = 68) only playground markings and game equipment were provided. The third school served as the control group (GC; n = 80). PA was assessed with pedometers. The increase in mean steps after intervention in G2 was higher than the G1 and GC ($P < 0.001$). No differences between G1 and GC were observed at post-intervention ($P = 0.05$). The effects did not vary by gender or BMI. Providing game equipment and playground marks may increase children PA in recess. Nevertheless, additional PE-based intervention did not imply an improvement, and was not effective in increasing PA. **Key words:** PHYSICAL EDUCATION, RECESS, PLAYTIME, CHILD.

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INTRODUCTION

The benefits of physical activity (PA) have been widely reported in all ages (Kokkinos, 2012). However, much of the world population is not meeting the minimum health recommendations of PA (Hallal et al., 2012). Moreover, the prevalence of inactivity has increased dramatically during the last decades, which has been well documented as promoting a deleterious health profile (Lee et al., 2012). Hence, the promotion of healthy PA has become a major concern for public health, especially in childhood (World Health Organization, 2010).

Because all children spend a significant part of their time at school, schools are ideal settings for the promotion of PA among children (Kahan, 2008). The school timetable offers two main opportunities for children to be physically active: recess periods and physical education (PE). Physical education classes alone do not satisfy the recommended levels of PA in schoolchildren, especially because the duration of PA in these classes is limited (Brink et al., 2010).

Several strategies for increasing PA in children during school recess have been successful (Ickes, Erwin, & Beighle, 2012; Parrish, Okely, Stanley, & Ridgers, 2013; Ridgers, Salmon, Parrish, Stanley, & Okely, 2012), providing playground markings (Ridgers, Stratton, Fairclough, & Twisk, 2007; Stratton & Leonard, 2002), game equipment (Hannon & Brown, 2008) or both (Lopes, Lopes, & Pereira, 2009). The organization of playground space can also be a way of increasing PA during recess (Loucaides, Jago, & Charalambous, 2009).

Other recess-based interventions have complemented, with positive results, equipment or playground markings with teacher supervision (Willenberg et al., 2010), teacher encouragement to play games (Verstraete, Cardon, De Clercq, & De Bourdeaudhuij, 2006) or a specific staff training for recess (Huberty, Beets, Beighle, & Welk, 2011; Siahpush, Huberty, & Beighle, 2012).

It seems that more structured recesses have been shown to increase moderate PA more than free-play recesses (Scruggs, Beveridge, & Watson, 2003). Other study used a structured recess including 22 games directed by trained research staff, which increased moderate and vigorous PA during recess (Howe, Freedson, Alhassan, Feldman, & Osganian, 2012).

On the other hand, PE is another strategy to promote PA among young people. Several studies about PE contribution to meet established PA guidelines have focused on interventions designed to increase the proportion of PE lesson time that students spend in moderate-to-vigorous PA (Lonsdale et al., 2013). This approach has some limitations. First, the number of PE hours per week is low in many cases (in [blind copy], one hour and a half per week in elementary education). Second, besides increasing PA, PE has other cognitive, emotional, and social objectives (Scruggs et al., 2003). To learn strategies during PE to increase PA during the whole day and throughout life should be more important than focusing on increasing PA just during PE lessons. In this way, PE is also an appropriate setting for learning the rules, tactics, and objectives of various games in order to be active outside the PE schedule (Lonsdale et al., 2013).

The influence that a PE teacher may have on children's PA behavior during recess has been suggested elsewhere (Beighle, Morgan, Le Masurier, & Pangrazi, 2006; Efrat, 2013; Huberty, Siahpush, et al., 2011; Sinclair, Stellino, & Partridge, 2008; Stellino & Sinclair, 2013) but, as far as we know, the possible effect on PA during recess of a PE-based intervention has not been researched. As most children participate in PE and recess, these interventions could lead to substantial public health benefits. Therefore, it is not clear whether providing equipment and playground markings and linking the playground to the PE curriculum yield the same changes in PA as just the provision of equipment and playground markings.

The aim of the present study was to determine whether providing equipment, painting playground markings, and integrating recess friendly games into the PE curriculum effectively increases elementary school children's PA levels during school playground recess.

MATERIAL AND METHODS

Participants

All children from three elementary schools (1^{st} and 2^{nd} grades) were invited to participate in the study. The parents of students who agreed to participate were provided with consent forms to sign. Of the 353 informed consents 336 were returned (95%). One hundred and thirteen were drop-outs from the final analysis because they did not complete all the assessments (i.e. sickness or absent from school on one of the eight registering days). The age, sex and BMI data of these students were similar to those who completed the intervention. Therefore, the final sample consisted of 223 children. The three schools were located in one large city in [blind copy] and were similar with respect to the number of children and physical characteristics of playground facilities (play space between 5.5 and 6 m^2 per child). The study was approved by the Ethics Committee of the University of [blind copy].

Measures

Body Mass Index. The Leicester portable stadiometer (Seca Ltd, Birmingham, UK) was used to measure height to the nearest 0.1 cm. Weight was measured to the nearest 0.1 kg using a portable digital scale (Tanita Corporation of America, Inc., Illinois, USA). Body mass index (BMI) was calculated as the weight in kilograms over height in meters squared (BMI = Weight (kg) / $Height^2$ (m^2)).

Physical Activity. The number of steps were assessed during recess by Dista Newfeel 100 pedometers (Oxylane, Villeneuve d'Ascq cedex, France), which appear to be valid pedometers for measurement of steps in this context.(López-Fernández, Pascual-Martos, & Alvarez-Carnero, 2013) The accuracy of all the pedometers used in this study was checked through a walking test and a shake test, following the procedure described by Vincent and Sidman (2003). None of the individual devices used showed more than 5% error (i.e., 5 steps out of 100) in any of the tests.

Procedure

All participants wore a pedometer on their waist, as recommended by the manufacturers. A classical protocol was used to record the steps; briefly, at the end of the last class before recess, one of the researchers placed a zeroed pedometer on to every participant. The researcher was present during the recess period to confirm participation. When students had finished recess, the same researcher registered the number of steps recorded by each pedometer and removed the devices. Every participant was tested during eight 30-minute recess periods (from 11:30 to 12:00) on eight different days: four consecutive days prior to the implementation of the intervention and another four consecutive days after the implementation of the intervention. Baseline assessments were performed during March 2012. The interventions took place in March/April 2012 and PA was measured again three weeks after the intervention began, when recess friendly games PE sessions had just finished.

The duration of recess, 30 minutes, was the same in the three schools. Recess staff were asked to minimize the motivational interaction with children during activities, and to act just to prevent accidents.

Interventions

The schools were randomly assigned to two interventions and one control group. The intervention in the first group (G1; n = 75) focused on providing playground markings (four hopscotch) and unfixed equipment, as well as conducting a previous six 45 minute PE sessions (two sessions per week during three weeks) to teach children 24 recess friendly games with the equipment supplied. Additionally, the play space was divided into several zones, each with equipment. Posters were put up as reminder of the rules of the games in each zone. Two first-grade and two second-grade students were responsible for distributing the equipment in their areas and collecting them at the end of recess. Children in other grades played anywhere in the playground except in the game courts. Equipment handed out to perform the games included three silicone flying discs, one giant ball, a traffic cone, three pairs of badminton rackets, three elastics for elastic games, three long ropes for group jump rope, 15 ropes for solo jump rope, several bottle caps, three plastic balls, two basketball balls, a set of bowling balls, three hand shuttlecocks, ten hoops, and eight pairs of stilts. The intervention in the second group (G2; n = 68) was only focused on providing the playground markings and unfixed equipment (as in the first intervention group), but without integrating recess friendly games into the PE curriculum and without putting up posters with the rules of the games. During the recess, children could play freely with the equipment and no explanations about how to play with these were given. The third school served as the control group (GC; n = 80).

Analysis

All variables were computed as means and standard deviations. Steps per minute were calculated in order to analyze pre- and post-intervention data. Additionally, two weight categories were established using BMI, namely healthy weight and overweight children; cut-offs used were selected according to the Cole et al. definition (2000). A three-way ANCOVA was conducted to examine potential differences in steps during the recess across time (pre-intervention, post-intervention), group (G1, G2, and GC) and gender, with steps per minute at pre-intervention as a covariate. Interaction between weight status and intervention effect was analyzed, where BMI categories at baseline were included as a second between-subject factor (time x group x weight status). Alpha significance value was set at 0.05 for all tests. Analyses were conducted using a statistical package (SPSS, Version 17.0, Inc, Chicago. IL).

RESULTS

Boys and girls were 7.10 years old on average. There was a balance between girls and boys (45.3% female). Forty percent of students were overweight (BMI, 17.8 ± 2.85 kg/m^2). Physical characteristics for total sample are shown in table 1.

Means and standard deviations for steps per minute during the 30-min recess across time before and after intervention are presented in table 2.

Results revealed a significant time by group interaction ($p < .001$, $\eta_p^2 = .50$). *Post hoc* tests showed mean steps per minute in GC were higher than the intervention groups ($p < .001$) at pre-intervention. There were also significant differences between the three groups at post-intervention. Mean steps in G2 were higher than the G1 and GC ($p < .001$). No differences between G1 and GC were observed at post-intervention ($p = .05$; figure 1).

Table 1. Descriptive anthropometric data for boys and girls in the intervention and control groups (M (SD)).

	Boys				Girls				Total
	G1 (*n* = 37)	G2 (*n* = 43)	GC (*n* = 42)	Total (*n* = 122)	G1 (*n* = 38)	G2 (*n* = 25)	GC (*n* = 38)	Total (*n* = 101)	(*n* = 223)
Age (years)	7.1 (0.6)	7.0 (0.6)	7.0 (0.7)	7.04 (0.6)	7.1 (0.6)	7.2 (0.7)	7.1 (0.6)	7.2 (0.6)	7.1 (0.6)
Height (m)	1.24 (0.07)	1.25 (0.07)	1.24 (0.06)	1.25 (0.06)	1.22 (0.06)	1.24 (0.04)	1.26 (0.07)	1.24 (0.06)	1.24 (0.06)
Body mass (kg)	28.5 (7.7)	28.1 (6.1)	27.5 (5.4)	28.0 (6.4)	26.6 (5.7)	27.0 (6.0)	29.0 (6.5)	27.6 (6.1)	27.8 (6.2)
BMI ($kg \cdot m^{-2}$)	18.2 (3.3)	17.8 (2.5)	17.7 (2.4)	17.8 (2.7)	17.7 (2.9)	17.6 (3.3)	18.1 (2.9)	17.8 (3.0)	17.8 (2.8)

Legend: BMI = body mass index; G1 = Intervention group 1; G2 = Intervention group 2; G3 = Control group; SD = Standard deviation

Table 2. Steps during the 30-min recess period across time (before and after the intervention), gender and group (M (SD)

		Pre-intervention			Post-intervention		
		Boys	Girls	Total	Boys	Girls	Total
G1	Steps	2379 (532)	1932 (451)	2153 (539)	2622 (508)	1940 (416)	2277 (574)
	Steps/min	79 (18)	64 (15)	72 (18)	87 (17)	65 (14)	76 (19)
G2	Steps	2601 (555)	2241 (525)	2469 (567)	3924 (831)	3714 (864)	3847 (843)
	Steps/min	85 (19)	73 (17)	80 (19)	132 (28)	125 (29)	130 (28)
GC	Steps	2729 (743)	2377 (748)	2562 (761)	2880 (719)	2414 (760)	2659 (771)
	Steps/min	94 (24)	82 (24)	88 (24)	103 (24)	86 (26)	95 (26)

Legend: G1 = Intervention group 1; G2 = Intervention group 2; G3 = Control group
F-values of interaction effects:
Time by school interaction effect: $F(2,221) = 110.30$, $p < .001$, $\eta_p^2 = .50$
Time by gender interaction effect: $F(2,221) = 6.63$, $p = .011$, $\eta_p^2 = .03$
School by gender interaction effect: $F(2,221) = 2.16$, $p = .118$, $\eta_p^2 = .02$
Time by school by gender interaction effect: $F(2,221) = 2.16$, $p = .118$, $\eta_p^2 = .02$

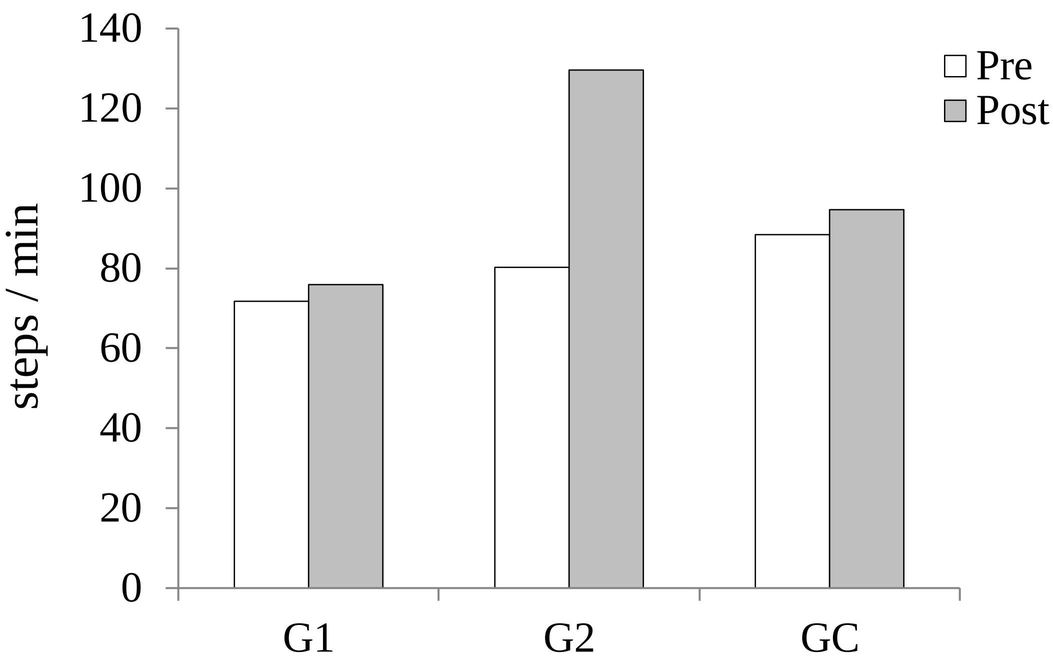

Figure 1. Average steps per minute during recess before and after the intervention in interventions and control groups

Repeated measured tests indicated that both boys and girls performed more steps at post-intervention than at pre-intervention in G2 ($p < .001$, $\eta_p^2 = .48$). The increment in boys was changed from 2601 to 3924 mean steps during recess and the increment in girls was changed from 2241 to 3714 mean steps during recess.

Boys registered more steps counts than girls both in pre-intervention and post-intervention ($p < .001$); a significant time by gender interaction effect was found ($p = .011$, $\eta_p^2 = .03$). No interaction was observed between gender, time, and group ($p = .118$, $\eta_p^2 = .02$; table 2).

No significant differences between healthy weight and overweight children were found (time x group x baseline weight status) ($p = .651$, $\eta_p^2 = .004$).

DISCUSSION AND CONCLUSIONS

We observed a large and significant increase in steps per minute during recess after the intervention period in G2. Considering that it is recommended that boys reach at least 13,000 steps per day and girls 11,000 steps per day (Tudor-Locke et al., 2011), G2 intervention contributed to a significant increase in total daily steps from recess time. Thus, the contribution of recess to the recommended steps per day in G2 showed a 20.0 to 30.2% increase in boys (2601 to 3924 steps), and the increment in girls was changed from 20.4 to 33.8% (2241 to 3714 steps). This result strengthens the potential contribution of recess to achieving the recommended levels of PA in children and reaffirms the usefulness and desirability of developing programs to promote PA in recesses, in accordance with several previous studies (Dobbins, De Corby, Robeson, Husson, & Tirilis, 2009; Ramstetter, Murray, & Garner, 2010; Verstraete et al., 2006).

However, the addition of recess friendly games in the PE curriculum did not yield any change in recess PA and no significant differences were observed between G1 and GC. It seems that painting playground markings and providing equipment may be enough to increase children's PA. Furthermore, it appears that the way of integrating recess friendly games into the PE curriculum interferes with the benefits of providing equipment and playground markings. There are some explanations that may help us to understand this result.

The more secondary role of the staff during the recess in G1 should explain the divergences with other studies where the most organized recesses reached the highest increases in PA (Howe et al., 2012; Huberty, Siahpush, et al., 2011; Scruggs et al., 2003). During the recess, no advice was offered in order to help with the recess friendly games in G1. It could be argued that when implementing specific games, the active participation of research or school staff during recess may be needed to increase PA more effectively and consistently, at least in short time interventions. This lack of transferability from a structured PA environment (ie, PE) to an unstructured PA environment (ie, recess) is consistent with previous research (Dobbins et al., 2009; Efrat, 2013).

On the other hand, making the playground a more challenging environment (i.e. providing equipment and playground markings) may promote creativity if we give children opportunities to explore material and to play by themselves (Bruce, 2011). For instance, we could observe a self-managed motivating tag during a recess in G2, when children were given freedom to play. As a consequence, they considered the ropes as snakes and the hopscotch as boats, so they played all around and throughout the recess. In G1 we told the children to use the equipment in a specific way to play the selected games, which might control and limit the spontaneous ideas of students. Therefore, the ropes were just for jumping and the ground marks just for playing hopscotch.

In G2 students could choose to use the equipment in any way they preferred, for instance, the option to change the rules. A study analyzed the freedom to make up or modify rules for games, which was perceived by students to be a facilitator of lunchtime play. In the same study, children remarked that they often changed current rules to suit personal and group skills, making play more attractive (Stanley, Boshoff, & Dollman, 2012). Since we did not register the characteristics of PA, we can only argue that in our intervention this freedom could just help children in G1 to make games funnier and provided motivation to play. This rationale suggests that creating and changing free-style activities to adapt to the competitive environment and the physical demands of children, can improve opportunities and increase enjoyment and motivation to participate in games (Humbert et al., 2008).

We observed that the effects of the interventions were uniform across gender and weight status. This finding has already been reported in other recess studies (Hannon & Brown, 2008; Howe et al., 2012; Siahpush et al., 2012), and it highlights the importance of such interventions, which also may benefit those children who are in most need.

The use of pedometers to measure PA objectively strengthens the internal validity of our findings, because pedometers are unobtrusive and valid measurement tools that are particularly well suited to determine children's PA levels (Hardman, Horne, & Rowlands, 2009). However, pedometers only detect ambulatory activity. Much of the latest research uses accelerometers, that enable the registration of frequency, duration and intensity of PA. Moreover, the use of an observational instrument may have benefited the findings, recording activity type and social interactions during play.

The sample size and the use of only one school in each condition is an important limitation of this study, restricting the generalizability of our findings. More schools would allow hierarchical analyses that consider the effects of clustering of participants within schools. Additionally, all schools were in [blind copy] and there may be environmental factors to consider. In this case, the climate permits PA to occur outdoors year-round.

This study suggested that providing game equipment and playground marks may increase children's PA during recess in the short-term. Nevertheless, additional teaching of recess friendly games in PE did not imply an improvement. It appears that the freedom to make decisions freely about how children can play during recess with the equipment may be a facilitator in enhancing PA enrolling. School-based PA interventions that involve one strategy may be less costly and more effective than interventions involving multiple strategies (Loucaides, Jago, & Charalambous, 2009). As the school setting provides a promising environment to increase children's PA since all children can be reached, these interventions could lead to substantial public health benefits. Results from this study provide useful information to design intervention programs that enhance children to be physically active.

Preliminary evidence presented here suggests simple strategies such as providing playground markings and recreational equipment during recess time may be an effective way to increase children's activity, despite gender or BMI, making a valuable contribution to the achievement of health-related PA recommendations for young people. As most children participate in recess, these interventions may be useful to address the childhood obesity epidemic and could lead to substantial public health benefits. Teaching games during PE children can participate in during recess may be not effective to ensure that children are getting more PA during recess, at least in short-term interventions when the adult supervision is limited during recess. A better understanding is needed of the role the PE teacher's involvement in teaching games has on children's PA during recess and further research is necessary into the effects of teaching recess games in PE on children's PA during recess, exploring the long-term effects of the interventions and using a larger sample of schools.

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