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Effects of a playground marking intervention on school recess physical activity in French children ☆

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ABSTRACT

Objective. Playground interventions offer an opportunity to enhance school recess physical activity. We aimed to assess the effects of playground marking on objectively measured school recess physical activity in French children.

Methods. Participants were four hundred and twenty children (6–11 years old) from 4 primary schools in Nord-Pas de Calais, France. Children's physical activity (PA) was measured with a uniaxial accelerometer twice a day (morning and afternoon recess) during a 4-day school week in April and May 2009. Two experimental schools (EG) received a recess-based intervention (playground markings) and two others served as controls (CG). Percentage of time spent on the following intensities of physical activity during school recess was measured before and after intervention: sedentary (SED), light physical activity (LPA), moderate physical activity (MPA), vigorous physical activity (VPA), very high physical activity (VHPA) and moderate-to-vigorous physical activity (MVPA).

Results. At baseline, school recess PA among children from CG was significantly ($p < 0.001$) higher than that among EG children. No interaction was observed between the recess-based intervention and gender. After the intervention, the EG spent significantly ($p < 0.05$) more time in MPA, VPA and MVPA with a concomitant significant decrease in SED ($p < 0.05$) compared to baseline, while the PA in CG remained unchanged.

Conclusion. Painted playground markings had a positive short-term effect on school recess physical activity levels.

Introduction

Previous studies have shown that the decline in children's physical activity (PA) might start at an early age (Nyberg et al., 2009; Reilly et al., 2004). Nyberg et al. (2009) suggested a biological explanation for this decline as spontaneous overall PA decreased not only during school days but also during weekends (Blaes et al., 2011; Nyberg et al., 2009). PA is important for the metabolic health of children. The World Health Organization (WHO, 2010) recommends that children should accumulate at least 60 min of moderate-to-vigorous intensity PA daily to provide health benefits and perform a minimum of three times a week of vigorous-intensity activities including those that strengthen the musculoskeletal system; achieving 90 min of daily activity might be necessary for children to prevent insulin resistance, which seems to be the central feature for clustering of cardiovascular disease risk factors (Andersen et al., 2006).

To improve children's PA levels many strategies can be implemented, including active commuting (Sirard et al., 2005), after-school PA programs (Trost et al., 2008), and school-based interventions (Taylor et al., 2011). Schools are an ideal setting to promote PA because most children attend school and thus can be targeted (Naylor and McKay, 2009). However, in some countries, schools are facing increasing pressure to improve standardized test scores in mathematics and science performance (e.g. in Europe, OECD Program for International Student Assessment, PISA report, 2009). Moreover, particularly in the US, many schools have significantly reduced the time allocated for recess, with some school districts eliminating recess completely (Lee et al., 2007). Further, PE in elementary schools has limited potential to significantly contribute to the daily PA levels of most young people (Parrish et al., 2009). Consequently, opportunities for children to engage in PA on a daily basis during the school day have declined considerably.

In response to these trends, researchers and educators have started to focus on opportunities to promote PA during school playtime or

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recess time (Ridgers et al., 2007a) and/or even after-school time periods (Trost et al., 2008). School recess time offers an opportunity for children to be physically active at a level that meets minimum daily PA recommendations (Ridgers et al., 2007a), and might be the only regular opportunity for the least active children to experience activity at moderate-to-vigorous (MVPA) and vigorous (VPA) intensities. French policies allow elementary children to participate in a 5-hour a week PE program, 2 recess periods of 15 min (morning and afternoon) and one lunchtime period (approximately 45 min). These policies provide an opportunity for children to be active during recess and to engage in meaningful amounts of PA (Gavarry et al., 1998). To date, several studies have shown that additional play equipment or playground marking is associated with increased total PA and MVPA during recess (Ridgers et al., 2010; Stratton, 2000; Stratton and Mullan, 2005). While recess interventions hold some promise, further research is needed to examine the effects of interventions in this context on children's PA and sedentary time in a range of geographical locations (Parrish et al., 2013), particularly as school policies relating to the frequency and duration of recess vary by country.

The primary purpose of this study was to determine the effect of playground markings on school recess PA and sedentary time in 6-to-11-year-old girls and boys. It was hypothesized that playground markings would increase children's recess physical activity levels independently of gender.

Methods

Participants

Four elementary schools located in the same geographical area in the north of France were recruited to participate in the study. Two schools were located in a low-socioeconomic area and 2 others were in a high socioeconomic area. There was no ethnic distribution of children. The elementary schools were representative of the Lille suburban area, had similar playground space (around 1300 m^2 and 1500 m^2) and were randomly assigned to experimental and control groups. Data collection began in April and May 2009. Four hundred and twenty children (206 girls and 214 boys) aged 6 to 11 years old and their guardians gave informed written consent to participate. The experimental group (EG) included 197 children (110 girls and 87 boys) and the control group (CG) 223 children (96 girls and 127 boys). The study was designed in accordance with the ethical standards of the Helsinki Declaration of 2008 and received approval from the “Comité Consultatif de Protection des Personnes en Recherche Biomédicale de Lille”.

Anthropometric measurements

Height was measured to the nearest 0.1 cm with a wall stadiometer (Vivioz Medical, Paris, France) and body mass was measured to the nearest 0.1 kg with a calibrated electronic balance (Tanita TBF 543, Tanita Inc., Tokyo, Japan). Body mass index (BMI) was calculated according to the equation: BMI = body mass (kg) / height^2 (m^2). Child weight status was based on the BMI percentile cutoff points (normal weight: 5%–<85%; overweight: 85%–<95% and obese 95% and above) according to the WHO (2006).

Physical activity monitoring

Children's PA was assessed with a uniaxial accelerometer (The ActiGraph®, Manufacturing Technologies, Inc., model GT1M), during school recess time (morning and afternoon), over 4 school days (Monday, Tuesday, Thursday and Friday). Wednesday was not included because children do not go to school on this day. In France, primary school children experience, on average, up to 288 recess periods per year, 36 weeks per year, with each recess period lasting about 15 min. For each child, data were obtained before and after intervention. The ActiGraph device facilitates the measurement of human movement (frequency and intensity) over a user-specified time epoch. In this study, the epoch was set at 2-s (Baquet et al., 2007). Accelerometers were distributed in the morning when the children arrived at school and were returned after the afternoon recess period. Data were downloaded at the end of each day using ActiLife 6 software for statistical analysis. Children wore the accelerometer on the right hip fastened with an elastic belt. Children's school recess PA was measured during 1 week before school holidays. During these holidays, each experimental school playground received multi-colored markings. After painting, a 2-week familiarization period with the new school playground space was given to the children. After this period, school recess PA was measured in similar conditions as previously described.

Interventions

All participating schools had similar playground space (around 1300 m^2 and 1500 m^2). The surface of the playground was in asphalt, and there was little greenery (e.g. trees, shrubs) in each school. The 2 experimental groups received specific playground markings with thermoplastic girdles (Magical Markings, UK), which cost 15,000 Euros per school. The intervention playground environment was based on the sporting playground zonal design (Stratton, 1999). This involved a playground division into three specific games (Ridgers et al., 2007b) and three color-coded areas: 1) a yellow ‘quiet zone’ with non-active games (e.g. chess and draughts), 2) a blue ‘multi-activity’ area for physical fitness and motor skill improvement, and 3) a red ‘sports’ area (e.g. football, basketball). Fun trails and dens, hopscotch or designs of dragons, clock faces, pirate ship, snakes or ladders were evenly spaced throughout the playground area. Prior to the intervention, the use of portable play equipment was not allowed by the intervention and control schools. Play equipment (e.g. rackets, balls, huge dies chess, scarfs, hockey sticks …) was provided in the intervention school playground areas by the schools following the redesign (Verstraete et al., 2006) (Fig. 1).

Data reduction

Files from children that had no complete morning and afternoon recess data (4 days at each time point) were deleted. Times spent below and above the different intensity thresholds — sedentary (SED < 1.5 METs), light (LPA, 1.5 METs ≤ LPA < 4 METs), moderate (MPA, 4 METs ≤ MPA < 6 METs), vigorous (VPA, 6 METs ≤ VPA < 9 METs) and very high (VHPA, VHPA ≥ 9 METs) were calculated. MPA, VPA and VHPA were summed to obtain time spent in MVPA. ActiGraph outputs were analyzed following the procedures of Trost et al. (2011). To compare the time spent in different PA levels between groups, PA time is reported as the percentage of total recess time. The average recess length lasted 15.5 min for the EG and 16.5 min for the CG.

Statistical analysis

Eighty-eight children (39 girls and 49 boys) did not have complete data (4 days at each time point) and were removed from the analyses. Finally, 332 children (167 girls and 165 boys) were retained for the statistical analysis. The experimental group included 169 children (96 girls and 73 boys) and the CG 163 children (71 girls and 92 boys). All values are expressed as mean ± standard deviation (mean ± SD). A comparison of BMI status following gender and groups was conducted using the Chi-squared test for independence.

Tests for normal distribution revealed that some of the physical activity data were skewed. Distributions that more closely approximated normal were obtained with Log transformation (Tabachnick and Fidell, 1996). Data, before and after intervention, were analyzed by two-way ANOVA (gender * intervention) using repeated measures on one factor (intervention: baseline and post-intervention). Newman–Keuls post hoc tests were carried out when ANOVA analysis revealed a significant difference or interaction between factors. Significance was accepted at $p < 0.05$. Statistical analyses were undertaken using Statistica 6 software (StatSoft Inc., Paris, France).

Results

Age and anthropometric data of children are presented in Table 1. Before the intervention, height ($p < 0.01$) and body mass ($p < 0.01$) in children from the CG were significantly greater when compared to those from the EG. BMI status was not significantly different between genders and groups.

Baseline data

Before the intervention, there was a significant difference in PA ($p < 0.001$) between the CG and EG at each intensity level (Table 2).