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Increasing physical activity in young primary school children — it's child's play: A cluster randomised controlled trial

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ABSTRACT

Objective. To explore the effects of an innovative school-based intervention for increasing physical activity.

Methods. 226 children (5–7 years old) randomly selected from 12 Australian primary schools were recruited to a cluster randomised trial with schools randomly allocated to intervention or control conditions. The 13-week intervention comprised: (1) altering the school playground by introducing loose materials and (2) a teacher–parent intervention exploring perceptions of risk associated with children's free play. The primary outcomes were total accelerometer counts and moderate–vigorous physical activity during break times. Testing took place in Sydney, 2009–2010.

Results. 221 participants were tested at baseline. Mixed-effect multilevel regression revealed a small but significant increase from the intervention on total counts (9400 counts, 95% CI 3.5 − 15.2, p = 0.002) and minutes of MVPA (1.8 min, 95% CI 0.5–3.1, p = 0.006); and a decrease in sedentary activity (2.1 min, 95% CI 0.5–3.8, p = 0.01) during break times. We retested children in one intervention school after 2 years; they maintained the gains.

Conclusions. Capturing children's intrinsic motivations to play while simultaneously helping adults reconsider views of free play as risky provided increases in physical activity during break times. Using accelerometry as the sole measure of physical activity may underestimate the effect.

Trial registration: ACTRN12611000089932.

Introduction

Engaging in regular physical activity as a child yields numerous benefits: increased physical fitness, bone and metabolic health (Andersen et al., 2006) and psychosocial competence (Lobo and Winsler, 2006). Similarly, physical *inactivity* is associated with increased risks, which often persist into adulthood and can contribute to the development of non-communicable chronic diseases (Park et al., 2012; World Health Organisation, 2010).

Schools and preschools are common sites for interventions to promote physical activity. These settings are ideal, as interventions benefit all children (World Health Organisation, 2009). Interventions at school generally occur in one of three contexts: within the curriculum (i.e., physical education [PE]), through staff training (Dobbins et al., 2009), and during break time (Ickes et al., 2012). Increasing the amount and nature of compulsory PE has resulted in increased physical activity (Kriemler et al., 2010), but competing academic demands and the requirement for staff time mean it is not always feasible to increase PE. Staff- and parent-based interventions include teacher training and the provision of education materials. While the education of adults is critical to increasing physical activity in children, lack of knowledge may not be the primary reason why adults fail to promote active free play. For example, concerns about litigation mean that educators may

Abbreviations: ICSEA, The Index of Community Socio-Educational Advantage; CRT, cluster randomised trial.

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discourage active play, such as cartwheels, on school playgrounds (Battles, 2004; Habib, 2012; Vines, 2012).

If break times are to promote physical activity in a sustained manner then available activities must be highly motivating, such as active play ("a playful context combined with a dimension of physical vigour") (Pellegrini and Smith, 1998), and have adults' support. In their recent review, Ickes et al. (2012) concluded that several simple strategies, including playground markings (Cardon et al., 2009; Ridgers et al., 2007) and play equipment (Cardon et al., 2009; Ridgers et al., 2007, 2010; Verstraete et al., 2006) are effective for increasing physical activity on school or preschool playgrounds. However, many studies they reviewed had a range of design shortcomings, including small samples, unequal number of groups, short duration of intervention, and failure to take clustering into account during analysis. The few studies using cluster randomised trial (CRT) procedures (e.g. (Cardon et al., 2009; Reilly et al., 2006)) generally failed to find significant effects. In the single exception, (Ridgers et al., 2007) increased vigorous physical activity (VPA) during lunch breaks using playground markings and physical structures. While those gains were greatest after 6 months, the actual increase in time was quite small and the trajectory was not maintained at 12 months (Ridgers et al., 2010).

We approached the problem of increasing physical activity at break time in a different way to previous studies. Based on pilot work conducted in 2005 (Bundy et al., 2008, 2009), we employed two strategies: First, we sought to capture and maintain children's *intrinsic* motivation to play (Deci and Ryan, 2008; Sutton-Smith, 1997) by introducing "loose parts" to the playground. The loose parts were primarily recycled materials with no obvious play value or direction (e.g., car tyres, weighted styrofoam boxes), selected to promote active, cooperative and creative play. Second, we addressed teachers' and parents' concerns about active free play in a joint workshop in which they actively explored their own experiences of free play and their beliefs regarding the benefits and risks associated with active free play. The likelihood of children experiencing injuries on the playground during the loose parts intervention was small, but fears of adults could have consequences for the implementation of the intervention. Thus, children's access to the loose parts was dependent on adults' agreement that some risk or uncertainty in the moment was acceptable in exchange for potential benefits to children's present and future well-being.

As the intervention involved modification of school playgrounds, we used a CRT with school as the unit of randomisation. We tested the effectiveness of the programme over 3 months in 12 primary schools (6 intervention, 6 control). We also re-assessed physical activity of the children in one intervention school after 2 years to examine long-term maintenance.

The objective of this study was to increase children's physical activity during break time at school through active free play, coupled with an adult directed intervention aimed at reframing risks often associated with free play.

Participants and methods

The protocol for this CRT was approved by the Human Research Ethics Committee at the University of Sydney and the Catholic Education Office of the Archdiocese of Sydney. The Catholic school system was chosen for convenience but it was known a priori that the schools vary widely in terms of socio-economic status and culture. Data were collected from June 2009 to December 2010 by research assistants and trained student researchers.

Schools and children

Twelve Catholic co-educational primary schools in Sydney, Australia participated in the study and were randomised to the control or intervention groups in equal numbers. Schools and researchers were blinded to the intervention allocation until the completion of baseline testing. Based on a priori power analysis (Bundy et al., 2011) we sought to recruit a random sample of 19 five to seven-year old children per school (total n = 226), representative of young primary school children in those schools. This age-group is under-researched and since the early establishment of good activity patterns are important in laying the foundation for activity habits later in life (Beunen et al., 1997; Malina, 2001), we choose to focus on the first years of schooling. Details of recruitment, eligibility and randomisation procedures, and sample size calculations have been published elsewhere (Bundy et al., 2011). In brief, the schools invited children and their parents to participate based on a set of randomly generated numbers matched with the eligible students (first and second year of schooling; parents having adequate knowledge of English) numbers until at each school, the required number of students and their parents consented in writing to participate.

Interventions

The intervention had two components: (1) a 13-week playground-based intervention and (2) a 2-hour adult intervention administered 2 to 3 weeks after the initiation of the playground intervention. Post-testing took place during the final week of the playground-based intervention. Children at the control schools participated in standard break times. They did not have access to the intervention materials and adults received no intervention.

Playground-based intervention. Loose, primarily recycled, materials were introduced on the school playgrounds to be used during all break times. The materials conformed to seven principles: (1) no obvious play value; (2) encourage co-operation and gross motor development; (3) multipurpose (4) can be used in challenging, creative and uncertain ways; (5) promote interesting sensory experiences; (6) potential hazards are easily seen or managed by children; and (7) re-use or very inexpensive items. Examples of play materials included car tyres, milk crates, and fabric. Some items, such as crash mats and weighted boxes, were fabricated by combining recycled materials (e.g., off cuts of foam sewn inside event flags, styrofoam boxes filled with newspaper and taped shut). All materials were "child and weather-proofed"; all met Australian standards for playground materials (AS 4685:2004 Pt 1 General safety requirements and test methods). New materials were added approximately every 3 weeks to replace broken objects and complement existing objects. Materials were accessible to all children at the school independent of project consent. Maintenance of the materials was the responsibility of the researchers in collaboration with each school community.

Adult-directed intervention. Teachers and other staff with playground duties, and parents of participating children from the intervention schools were invited to participate in a 2-hour group intervention. The adults participated in small groups ($n = 6$–8), engaged in a series of tasks as well as large whole-group discussions ($n = 18$–24) to examine their own experiences of free play and their beliefs regarding the benefits and risks associated with active free play. Discussions focused on parents' and teachers' perceptions of the benefits of play, and the consequences of preventing children from engaging in play and healthy risk taking. Details and qualitative results of the adult-directed intervention are discussed in Niehues et al. (in press).

Outcome measures

Physical activity. The primary outcome measure, children's physical activity, was measured with Actigraph accelerometers (model GT3X, www.theactigraph.com) fastened on top of clothing with an elastic waist band on the left iliac crest. A researcher attached the accelerometers at 9.00 AM and removed them at 3.00 PM on five consecutive school days, at baseline and post-test. Data were recorded in 5 second epochs but reintegrated to 15 s to fit the cut-off point algorithm. Accelerometers provided total activity counts as well as estimates of time spent in sedentary, light or moderate–vigorous intensity physical activity (MVPA) using existing cut-off points for children (Evenson et al., 2008). Although accelerometer cut-off points have well-documented limitations, the algorithm we used was recently recommended for this age group (Trost et al., 2011).

Predictor variables

Anthropometry. Height and weight were measured using standard procedures. Height was measured using a portable stadiometer (PE087, Mentone, Mentone, VIC, Australia; mentone-educational.com.au) to the nearest 0.1 cm. Weight was measured in a single measurement wearing school uniform (without shoes), to the nearest 0.1 kg using digital scales (UC-321, A&D Weighing, Adelaide, SA, Australia, www.andweighing.com.au). Body mass