Mental Health and Physical Activity 7 (2014) 129–134

Contents lists available at ScienceDirect

Mental Health and Physical Activity

journal homepage: www.elsevier.com/locate/menpa

A short physical activity break from cognitive tasks increases selective attention in primary school children aged 10–11

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ARTICLE INFO

Article history:
Received 17 April 2014
Received in revised form
1 July 2014
Accepted 1 July 2014
Available online 8 August 2014

Keywords:
Physical activity
Selective attention
Exercise
Cognition
School setting

ABSTRACT

Importance: Evidence for an acute effect of physical activity on cognitive performance within the school setting is limited. The purpose of this study was to gain insight into acute effects of a short physical activity bout on selective attention in primary school children, specifically in the school setting.
Methods: Hundred and twenty three 10–11 years old children, 49.6% girls, engaged in four experimental breaks in random order: 1 h of regular cognitive school tasks followed by a 15 min episode with the following conditions 1) 'no break' (continuing a cognitive task), 2) passive break (listening to a story), 3) moderate intensity physical activity break (jogging, passing, dribbling) and 4) vigorous intensity physical activity break (running, jumping, skipping). Selective attention in the classroom was assessed by the TEA-Ch test before and after the 15 min break in each condition.
Results: After the passive break, the moderate intensity physical activity break and the vigorous intensity physical activity break attention scores were significantly better ($p < 0.001$) than after the 'no break' condition. Attention scores were best after the moderate intensity physical activity break (difference with no break = −0.59 s/target, 95% CI: −0.70; −0.49).
Conclusion: The results show a significant positive effect of both a passive break as well as a physical activity break on selective attention, with the largest effect of a moderate intensity physical activity break. This suggests that schools could implement a moderate intensity physical activity break during the school day to optimize attention levels and thereby improve school performance.
Trial registration: NTR2386.

1. Introduction

Because children spend a large part of their regular days in school, schools have been recognized as key settings for promoting physical activity (PA) in children (Naylor & McKay, 2009). However, the primary priority for schools is to provide a tailored curriculum in order to help children to develop their knowledge, understanding and cognitive skills. These two statements seem contradictory. However, research has shown that additional time for cognitive subjects does not necessarily lead to an improvement in academic performance (Ahamed et al., 2007). Interestingly, less time for cognitive subjects and more time allotted to PA also do not necessarily reduce academic performance (Leppo, Davis, & Crim, 2000). A recent review revealed evidence for a significant positive relationship between PA and academic performance (Singh, Uijtdewilligen, Twisk, van Mechelen, & Chinapaw, 2012).

In addition to the described positive relationship between PA and academic performance, the literature on the acute effect of PA on cognition is expanding. A meta-analysis by McMorris and Hale (2012) showed positive significant effects of moderate intensity exercise and a possible negative effect of high intensity exercise. Also in children, acute and chronic exercise has shown positive effects on cognition (Best, 2010; Hillman, Kamijo, & Scudder, 2011). However, there is a lack of knowledge about the effects of different PA intensities on cognition in children.

There are several mechanisms which could explain an effect of acute aerobic types of PA on cognition, such as increased blood and

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http://dx.doi.org/10.1016/j.mhpa.2014.07.001
1755-2966/

oxygen flow to the brain (Jorgensen, Nowak, Ide, & Secher, 2000), and increased hormone levels (Fleshner, 2000) argued to lead to stress reduction.

However, the evidence from the acute effect of PA on central executive tasks (e.g. selection, initiation, and termination of processing routine) is more robust than the effect on attention tasks (McMorris & Hale, 2012). Attention is defined as the ability to resist distraction. Selective attention is the ability to process specific target information while ignoring irrelevant information (Heaton et al., 2001), resulting in increased efficiency, improved sensory discrimination and is helpful for memory.

Attention is important for several aspects of learning and memory storage; attention is required when learning something (to encode the information), but also when recalling a memory (Hillman, Snook, & Jerome, 2003). Deficits in attention are associated with poorer academic performance (Aronen, Vuontel, Steenari, Salmi, & Carlson, 2005).

Moreover, the acute effect of PA on attention in a school setting is limited, due to differences in study design, and different study samples (Hillman et al., 2011; Janssen, Toussaint, Van Mechelen, & Verhagen, in press). In addition, as mentioned above, there is a lack of knowledge about the effects of different PA intensities on cognition in children. Therefore, the purpose of this study was to gain insight into acute effects of experimental PA breaks of different intensity on selective attention in 10–11 year old primary school children, in which aerobic fitness was measured as a covariate.

2. Methods

2.1. Procedure

Between September and December 2011, a convenience sample of seven classes from four primary schools (n = 123 children) participated in a randomized cross-over experiment, with a within-design. All experimental breaks took place between 09.30 and 10.00 after an hour of regular cognitive tasks that were scheduled at that moment. The measurements were conducted with one week intervals. Each participating class was visited five times. At the first visit, children completed the selective attention test three times. The purpose of this first measurement was to acquaint children with the test and the test protocol, and to reduce potential test-learning effects. On the subsequent visits the different experimental breaks (no break, passive break, moderate intensity PA break, vigorous intensity PA break) were administered, in random order (Fig. 1).

Each experimental break lasted 15 min and was supervised by two researchers and the classroom teacher. Selective attention was assessed before and after each experimental break in the classroom.

2.2. Participants

The sample included 123 children from the 5th grade, aged 10–11. The participants were recruited from 4 schools (7 classes) that also participated in the PLAYgrounds study (Janssen, Twisk, Toussaint, van Mechelen, & Verhagen, 2013). Schools were located in the urban area of Amsterdam in neighborhoods with a relatively large part of the population of immigrant origin and low socio-economic status. The school register provided demographic information (age and gender). Similar to a previous school-based study (Collard, Chinapaw, Verhagen, Bakker, & van Mechelen, 2010), parents of the participating children received a passive informed consent form that explained the nature and procedures of the study allowing them to withdraw their child if they objected to study participation. The Medical Ethics Committee of the VU University Medical Centre approved the study design, protocols and passive consent procedure (NTR2386).

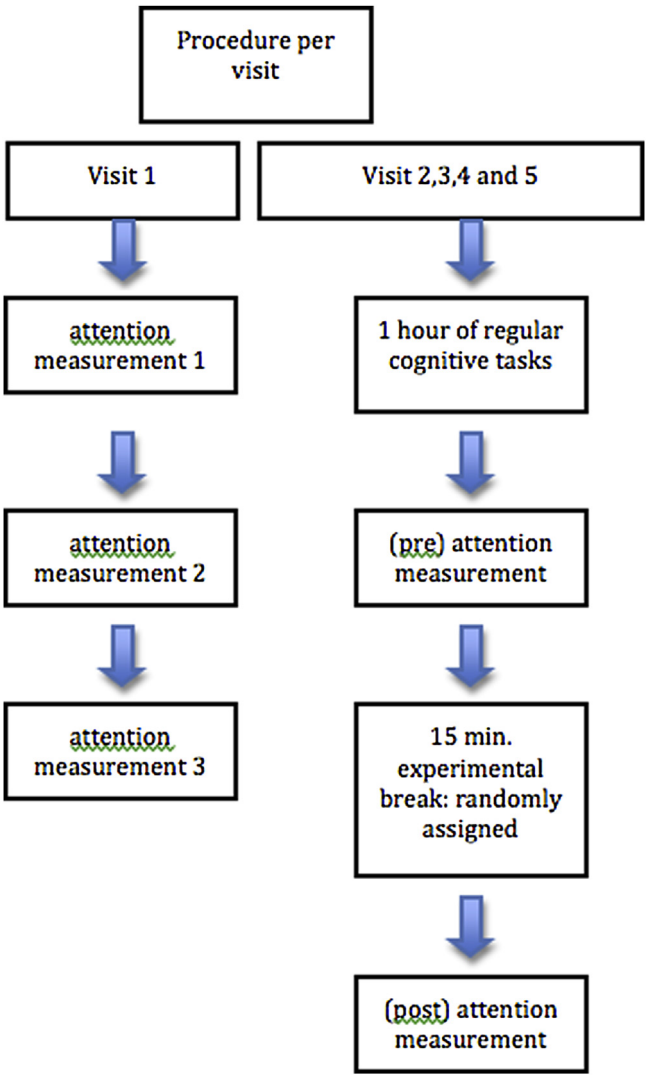

Fig. 1. Flow diagram of the procedure.

2.3. Experimental breaks

Each experimental break lasted 15 min in total, which equals a morning break in Dutch primary schools. The experimental breaks were administered in a random order.

The first experimental condition was 'no break', in which children continued their cognitive tasks (i.e. mathematics or language exercises) instead of a 'real' break. They were not allowed to ask the teacher for help or go to the toilet.

The second experimental break was a passive break. The teacher read out aloud a story to the children. Children were neither physically active nor performing difficult cognitive tasks.

The third experimental break was an exercise break consisting of moderate intensity PA and included walking to and from the PE classroom. All exercises in the PE classroom were instructed by the researcher and consisted of a combination of jogging, passing of the ball and dribbling with the ball. For example, the children worked in groups of three and had to pass the ball to another child who stood opposite them and then run in the same direction. The next child did the same toward the third child, and so on.