

PHYSICAL EDUCATION PROGRAM IMPROVES STUDENTS' EXECUTIVE ATTENTION

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Regular physical exercise improves cognitive functions throughout the life span. In particular, executive functions (EFs) that are highly important for learning achievement can be improved by physical activity. Because exercise interventions in early childhood programs and schools can be effective in enhancing school readiness and academic success through their influence on EFs, it is important to study possible beneficial effects of school sports programs in this age groups.

Executive Functions and Learning Achievement

EFs are of major importance for learning achievement in content areas such as language, mathematics, and science throughout the school years. Working memory stores about seven elements (such as words, objects, and numbers) for only a few seconds. Moreover, working memory allows operating with short-term stored information. Working memory is also needed to retrieve long-term stored information. Behavior is thus not only induced by current but also by (reactions to) earlier information. A functioning working memory is therefore a precondition for goal-directed behavior.

In physical education (PE), for instance, students with high self-regulatory skills are much less willing to foul teammates in order to reach a victory. Self-regulation that supports positive and suppresses disruptive emotions is an important key to success in life, and successful goal-directed and self-regulated behavior enables students to put their knowledge to appropriate use. An additional element of EFs is cognitive flexibility that is based on inhibition and working memory. Cognitive flexibility is the ability to react on altering conditions and demands. Cognitive flexibility supports the taking up of different perspectives respectively to switch between different perspectives, and therefore to think and react in a flexible way.

Executive Functions and Physical Activity

EFs can be improved by acute and chronic physical activity (especially aerobic endurance exercise) in populations of depressive patients, in healthy old and young adults as well as in preadolescents and adolescents. One possible mechanism for improving EFs by physical activity could be based on changes in brain chemistry. EFs are influenced by transmitter systems such as dopamine and serotonin. Physical activity influences central dopaminergic and serotonergic systems. Aerobic endurance exercise, when carried out for approximately half an hour and longer leads, first, to a lipolysis-elicited increase in blood-free tryptophan.

Indeed, studying the effects and benefits of physical activity and physical performance in students is a promising research area because school and therefore PE are mandatory for students. Furthermore, because EFs are of major importance for students' learning achievement, it is essential to clarify to what extent EFs can be improved by school sports programs of different duration and intensity. Today, compared with other school subjects, PE is still given a low level of attention especially with regard to the promotion of academic achievement.

Objective - theoretically and experimentally justify the use of physical education in higher education for improving students' executive attention.

Methods: theoretical analysis and synthesis of the literature; anthropometric methods, physiological methods of research; teacher testing; psychophysiological research methods;

Two different exercise programs were standardized for the study. The PE program consisted of a 30-min predominantly aerobic endurance exercise session. This treatment condition was executed by the PE teachers and was focused on exercise intensity of students' individual performance. In the control condition, students were listening to a 30-min audio book. The MB was also an aerobic endurance exercise session but with a duration of only 5 min. In the control condition, students watched the other students taking part in the 5-min MB. Initially, the teachers were introduced in the PE program and in the MB program.

DISCUSSION

In our study, we showed that a single PE program of 30 min leads to an improvement in the maintenance of ontask attention in the face of distraction. This in turn may support students' selective, sustained, and focused attention processes.

We further suggest that a possible increased synthesis of serotonin after the 30-min PE program may directly lead to an increased serotonergic tone and consequently to the improvement in the incongruent condition of the flanker task. Study results suggest that a serotonergic modulation in the prefrontal cortex occurs simultaneously with decreased impulsivity to increased attentional selectivity

Our study results provide arguments for an increase in PE and suggest that PE should be scheduled before important subjects like mathematics and not at the end of the school day, as is often the case. Because students' physical fitness seems to be more relevant than an acute bout of exercise for improving students' EFs, this further strengthens arguments for more PE because higher fitness could not be achieved with short MBs. Short MBs could have effects on cognitive functions if they include coordinative exercises of 10 min; or, if they are highly intensive (two sprints of 3 min. However, if one wants to expose students to high-intensity physical exercise, they should be well trained. This argues again for more, ideally daily, PE lessons

It is worthy of further investigation.