

# Aerobic exercise enhances executive function and academic achievement in sedentary, overweight children aged 7–11 years

## Synopsis

Summary of: Davis CL et al (2011) Exercise improves executive function and achievement and alters brain activation in overweight children: a randomized controlled trial. *Health Psychol* 30: 91–98. [Prepared by Nora Shields, CAP Editor.]

**Question:** Does aerobic exercise improve cognition and academic achievement in overweight children aged 7–11 years? **Design:** Randomised, controlled trial with concealed allocation and blinded outcome assessment. **Setting:** After school program in the United States. **Participants:** Overweight, inactive children aged 7–11 years with no medical contraindication to exercise. Randomisation of 171 participants allocated 56 to a high dose exercise group, 55 to a low dose exercise group, and 60 to a control group. **Interventions:** Both exercise groups were transported to an after school exercise program each school day and participated in aerobic activities including running games, jump rope, and modified basketball and soccer. The emphasis was on intensity, enjoyment, and safety, not competition or skill enhancement. The student-instructor ratio was 9:1. Heart rate monitors were used to observe the exercise intensity. Points were awarded for maintaining an average of > 150 beats per minute and could be redeemed for weekly prizes. The high dose exercise group received 40 min/day aerobic exercise and the low dose exercise group received 20 min/day aerobic exercise and 20 min/

day unsupervised sedentary activities including board games, drawing, and card games. The average duration of the program was  $13 \pm 1.6$  weeks. The control group did not receive any after school program or transportation. **Outcome measures:** The primary outcome was the Cognitive Assessment System taken at baseline and post-intervention. This measure tests four cognitive processes: planning (or executive function), attention, simultaneous, and successive tasks with each process yielding a standard score with a mean of 100 and a SD of 15. Secondary outcome measures were the broad reading and mathematics clusters of the Woodcock-Johnson Tests of Achievement III. **Results:** 164 participants completed the study. At the end of the intervention period, there was a dose-response benefit of exercise on executive function (linear trend  $p = 0.013$ ) and mathematics achievement (linear trend  $p = 0.045$ ); ie, the post-intervention group scores for these outcomes increased with the intensity of exercise. Compared to the control group, exposure to either exercise program resulted in higher executive function scores (mean difference =  $-2.8$ , 95% CI  $-5.3$  to  $-0.2$  points) but not in higher mathematics achievement scores. The groups did not differ significantly on any of the other outcomes. There were no differences between the two exercise groups. **Conclusion:** Aerobic exercise enhances executive function in overweight children. Executive function develops in childhood and is important for adaptive behaviour and cognitive development.

## Commentary

As the global prevalence of paediatric obesity rises, participation in health-enhancing physical activity is of vital importance for the prevention of chronic diseases such as Type 2 diabetes, cardiovascular disease, coronary heart disease, and some cancers (Penedo and Dahn 2005). The reported global prevalence of 'some but insufficient physical activity' is estimated to be associated with 1.9 million deaths, 19 million Daily Adjusted Life Years, and approximately 22% of coronary heart disease prevalence globally (WHO 2002).

The study by Davis et al highlights the benefit of increasing physical activity in childhood for parameters of health other than weight management alone and provides evidence for the positive effect of increasing physical activity on mental functioning. This well-designed study uses robust techniques to explore the dose-response relationship between activity levels and executive function and expands the evidence for the importance of human movement in overall physical and cognitive health in childhood which, at times, can be lacking (Biddle et al 2011). The authors did not collect data relating to the cost associated with achieving such benefit, however, and this information would be very useful for policy makers.

Overall the study assists policy makers and clinicians in weighing up the benefit of implementing physical activity interventions. Given the positive effect, the results may support stakeholders' efforts to increase exercise time during the school day where curriculum demands can sometimes act as a barrier to such initiatives. Similarly, such school or community interventions should be appropriately designed to maximise the associated benefits (Baker et al 2011).

Grace O'Malley

Weight Management, Physiotherapy Department, The Children's University Hospital, Dublin, Ireland

## References

- Baker et al (2011) *Cochrane Database Syst Rev* 13(4): CD008366.
- Biddle SJ et al (2011) *Br J Sports Med* 45: 886.
- Penedo FJ, Dahn JR (2005) *Curr Opin Psychiatry* 18: 189.
- World Health Organization (2002) *World Health Report 2002: reducing risks, promoting healthy life.*