

# 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

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# Questioning the role of targeted respiratory physiotherapy over and above a standard clinical pathway in the postoperative management of patients following open thoracotomy

## Synopsis

Summary of: Reeve JC et al (2010) Does physiotherapy reduce the incidence of postoperative pulmonary complications following pulmonary resection via open thoracotomy? A preliminary randomised single-blind clinical trial. *Eur J Cardiothorac Surg* 37: 1158–1166. [Prepared by Kylie Hill, CAP Editor.]

**Question:** Does routine prophylactic targeted respiratory physiotherapy after elective pulmonary resection via open thoracotomy decrease the incidence of postoperative pulmonary complications and reduce length of hospital stay? **Design:** Randomised, controlled trial with concealed allocation in which those who collected outcome measures were blinded to group allocation. **Setting:** Hospital ward of a tertiary referral centre in Auckland, New Zealand. **Participants:** Adults scheduled for pulmonary resection via open thoracotomy. Exclusion criteria: (i) unable to understand written and spoken English, (ii) tumour invasion of the chest wall or brachial plexus, (iii) physiotherapy for a respiratory or shoulder problem within 2 weeks prior to admission, (iv) development of a postoperative pulmonary complication prior to randomisation on Day 1 postoperatively, or (v) intubation and mechanical ventilation  $\geq 24$  hours following surgery. Randomisation of 76 patients allocated 42 to the intervention group and 34 to the control group. **Interventions:** Both groups received usual medical

and nursing care via a standardised clinical pathway, which included early and frequent position changes, sitting out of bed on the first postoperative day, early ambulation and frequent pain assessment. In addition, the intervention group received daily targeted respiratory physiotherapy, which comprised deep breathing and coughing exercises, assistance with ambulation, and progressive shoulder and thoracic cage exercises. **Outcome measures:** The primary outcome was incidence of postoperative pulmonary complications, defined using a standardised diagnostic tool. The secondary outcome was the length of hospital stay. **Results:** The primary and secondary outcomes were available for all enrolled patients. Neither the incidence of postoperative pulmonary complications [mean difference intervention-control 1.8% (95% CI -10.6 to 13.1%)] nor the hospital length of stay [intervention group median 6.0 days, control group median 6.0 days;  $p = 0.87$ ] differed significantly between groups. The overall incidence of postoperative pulmonary complications (3.9%) was lower than expected. **Conclusion:** In adults following open thoracotomy, the addition of targeted respiratory physiotherapy to a standardised clinical pathway that included early mobilisation did not reduce the incidence of postoperative pulmonary complications or change length of hospital stay.

## Commentary

This study is a high-quality randomised controlled trial, and novel in comparing the efficacy of a postoperative physiotherapy program with a no-physiotherapy control group in patients undergoing open lung resection. Findings accord with the conclusion of a systematic review of physiotherapy after cardiac surgery (Pasquina et al 2003) that there is no evidence of benefit of routine, prophylactic respiratory physiotherapy over standard medical/nursing care. In response, one would anticipate that physiotherapists working in this field, particularly those in Australia and New Zealand (Reeve et al. 2007), would re-examine their current practices.

Notably, primary and secondary outcomes exhibited 'floor' effects, testament to the quality of care in such a first world, tertiary referral hospital setting. Postoperative pulmonary complication (PPC) incidence for the study cohort was remarkably low (3.9%), as was length of stay (median 6 days, against the median 4–5 days to chest drain removal), suggesting limited scope for physiotherapy-mediated reductions.

The described 'respiratory-targeted' physiotherapy program was arguably equally focussed on restoration of physical function through mobilisation and limb exercises. This raises the larger question of the role of physiotherapy

for thoracic surgical populations. Is our putative role solely to prevent complication? Or is it to accelerate the return to pre-morbid function? Interestingly, secondary findings of the study (Reeve et al 2010) showed that the physiotherapy program did improve shoulder pain/function at discharge.

Notwithstanding economic pressures to rationalise healthcare, wholesale withdrawal of respiratory physiotherapy services from thoracic surgical units would likely meet opposition, from both surgical teams (being cognisant of the severity of PPC when it does occur) and physiotherapists themselves. Redefining the role of physiotherapy in terms of: i) identification of high (PPC) risk patients, ii) treatment of those (few) patients developing PPC, and/or iii) restoration of pre-morbid physical function, would appear a prudent method of 'translating' this evidence into practice.

**Andrew Hirschhorn**

*Westmead Private Physiotherapy Services,  
Clinical Research Institute, Sydney, Australia*

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# Surgery with disc prosthesis may produce better outcomes than multidisciplinary rehabilitation for patients with chronic low back pain

## Synopsis

Hellum C et al (2011) Surgery with disc prosthesis versus rehabilitation in patients with low back pain and degenerative disc: two year follow-up of randomised study. *BMJ* 342: d2786 doi:10.1136/bmj.d2786. [Prepared by Margreth Grotle and Kåre Birger Hagen, CAP Editors.]

**Question:** What are the effects of surgery with disc prosthesis compared to multidisciplinary rehabilitation for patients with chronic low back pain? **Design:** A single blind randomised controlled multicentre trial. **Setting:** Five university hospitals in Norway. **Participants:** Men and women 25–55 years with low back pain as the main symptom for at least one year, physiotherapy or chiropractic treatment for at least six months without sufficient effect, a score of at least 30 on the Oswestry disability index, and degenerative intervertebral disc changes at L4/L5 or L5/S1, or both. Patients with nerve root involvement were excluded. Randomisation of 179 participants allocated 86 patients to surgical treatment and 87 to rehabilitation. **Interventions:** Rehabilitation consisted of a cognitive approach and supervised physical exercise directed by physiotherapists and specialists in physical medicine and rehabilitation. Intervention was standardised and organised as outpatient treatment in groups; it lasted for about 60 hours over 3–5 weeks. Follow-up consultations were conducted at 6 weeks,

3 and 6 months, and 1 year after the intervention. Surgical intervention consisted of replacement of the degenerative intervertebral lumbar disc with an artificial lumbar disc. Surgeons were required to have inserted at least six disc prostheses before performing surgery in the study. Patients were not referred for postoperative physiotherapy, but at 6 weeks follow-up they could be referred for physiotherapy if required, emphasising general mobilisation and non-specific exercises. **Outcome measures:** The primary outcome was the Oswestry Disability Index (ODI, 0–100 scale) at 2 years. Secondary outcomes included low back pain (0–100 VAS), SF-36, and EQ-5D scores. **Results:** The drop-out rate at 2 years was 15% in the surgical arm and 24% in the rehabilitation arm. At 2 years follow up, the between group differences (95% CI) in favour of the surgical treatment were –8.4 (–13.2 to –3.6) for ODI, –12.2 (–21.3 to –3.1) for pain, and 5.8 (2.5 to 9.1) for SF-36 physical health summary. No differences were found in SF-36 mental health summary or EQ-5D. **Conclusion:** Surgery with disc prosthesis produced significantly greater improvement in variables measuring physical disability and pain, but the difference in ODI between groups did not exceed the pre-specified minimally important difference of 10 points, so it is unclear whether the observed changes were clinically meaningful.

## Commentary

Disc replacement in chronic low back pain has shown promising results during the past decades, showing at least equivalent effects to that of fusion surgery (Berg et al 2009). The present study represents an important contribution comparing surgery with disc prosthesis with multidisciplinary rehabilitation. This well-designed and executed multicentre study demonstrates that surgery is superior to multidisciplinary treatment when measured by disability and pain, but the difference in the main outcome Oswestry of 8.4 points was smaller than the difference of 10 points that the study was designed to detect. As there is no consensus regarding how large the difference between groups must be in order to demonstrate clinical importance, it is not possible to conclude that the difference in effect in this study is of clinical importance. However, clinical important improvement for one individual was defined as 15 points on Oswestry, and 70% in the surgical group versus 47% in the rehabilitation group achieved this improvement, supporting the positive effect of disc replacement. It should also be mentioned that both groups experienced considerable improvement. A limitation of the study is the lack of a control group. The placebo effect might have been higher in the surgery group due to patient expectation of surgery, although possible placebo effects after several

weeks of personal contact during rehabilitation should not be underestimated, and these effects may be counterbalanced. Indications were found that patients with Modic I and II disc changes may have a superior result in the surgery arm while patients with a high Oswestry score may be more suitable for rehabilitation, and this result underlines that it is important to select treatment individually for each patient. Surgery carries a risk of serious complications and these occurred in one patient in the study. This risk of complication and the considerable improvement also demonstrated in the rehabilitation group, in addition to the mixed causes of chronic low back pain, support the view that it is reasonable to consider multidisciplinary rehabilitation before surgery in chronic low back pain.

**Liv Heide Magnussen**

*Department of Physiotherapy, Faculty of Health and Social Sciences, Bergen University College, and Department of Public Health and Primary Health Care, Physiotherapy Research Group, University of Bergen, Norway*

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# Manual lymph drainage when added to advice and exercise may not be effective in preventing lymphoedema after surgery for breast cancer

## Synopsis

Summary of: Devoogdt N et al (2011) Effect of manual lymph drainage in addition to guidelines and exercise therapy on arm lymphoedema related to breast cancer: randomized controlled trial. *BMJ* 343: d5326. [Prepared by Nicholas Taylor, CAP Editor.]

**Question:** Does manual lymph drainage prevent lymphoedema in patients who have had surgery for breast cancer? **Design:** Randomised, controlled trial with concealed allocation and blinded outcome assessment. **Setting:** A multidisciplinary breast centre of a tertiary hospital in Belgium. **Participants:** Patients were eligible to be included if they received unilateral surgery with axillary node dissection for breast cancer, and agreed to participate. Randomisation of 160 participants allocated 79 to the intervention group and 81 to a control group. **Interventions:** Both groups received guidelines about the prevention of lymphoedema in the form of a brochure, and exercise therapy involving supervised individualised 30 minute sessions – initially twice a week, reducing to once fortnightly as patients progressed. Participants in both groups were also asked to perform exercises at home twice/day. In addition, the intervention group received 40

sessions of manual lymph drainage over 20 weeks with each session lasting 30 minutes and performed by trained therapists. **Outcome measures:** The primary outcomes were the cumulative incidence of and the time to develop arm lymphoedema (defined as a 200 ml increase) as measured with the water displacement method with measures taken at baseline and 1, 3, 6, and 12 months after surgery. Secondary outcome measures were lymphoedema measured with the arm circumference method, health-related quality of life using the SF-36 scale, and a patient reported questionnaire to score the presence of subjective arm lymphoedema. **Results:** 154 participants (96%) completed the study at 12 months. At 12 months the incidence of lymphoedema in the intervention group (n = 18, 24%) was similar to the incidence of lymphoedema in the control group (n = 15, 19%, OR 1.3, 95% CI 0.6 to 2.4); also there was no difference in incidence at 3 or 6 months. There was no difference between the groups in the time taken to develop lymphoedema, and no difference between the groups in any secondary outcome measure. **Conclusion:** The application of manual lymph drainage after axillary node dissection for breast cancer in addition to providing guidelines and exercise therapy did not prevent lymphoedema in the first year after surgery.

## Commentary

The development of arm lymphoedema after axillary node dissection for breast cancer management has been estimated to occur in 20–40% of women (Coen 2003, Hayes 2008). The effect on quality of life for the individual and the cost to public health is well recognised. Therefore any research exploring the possibility of reducing the development of lymphoedema is welcome. Devoogdt used manual lymphatic drainage, one of the cornerstones of treatment for established lymphoedema, in this study (Földi 2003). Combined with exercise and education the aim was to prevent lymphoedema. Intuitively every lymphoedema therapist would agree that this would be worthy of pursuit. However, this study does not show any benefit from the addition of manual lymphatic drainage. The incidence of lymphoedema within the first year is nearly equal in both groups. This is in stark contrast to Torres Lacomba's study (2010), also a randomised, single blinded clinical trial, including 120 women. Their intervention was manual lymphatic drainage, exercise, and education, compared to education alone. The results showed that after one year the incidence of lymphoedema in the intervention group was 7% compared to 25% in the control group.

Comparing the two studies the question arises whether exercise had a major impact and accounted for the better results in Torres Lacomba's study. Exercise has been shown to be beneficial in early post-operative physiotherapy

programs (Box 2002). In both of these studies similar exercise programs were used, but Devoogdt's incidence of lymphoedema was high in both the intervention and control group. The interventions were delayed in Devoogdt's study (4–5 weeks after surgery) while the Torres Lacomba intervention started 3–5 days after discharge from hospital, which might also have had some impact on outcome. How many manual lymphatic drainage sessions are required to reduce the incidence of lymphoedema if at all? Devoogdt used 40 sessions compared to 9 in the Torres Lacomba study. Further research is required to answer the questions and to determine the benefit of adding manual lymphatic drainage to early postoperative physiotherapy interventions.

**Hildegard Reul-Hirche**

*Physiotherapy Department, Royal Brisbane and Women's Hospital, Brisbane, Australia*

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