Loaded sit-to-stand resistance exercise improves motor function in children with cerebral palsy

Synopsis


Question: What is the effect of loaded sit-to-stand resistance exercise on motor activity, muscle strength, and walking speed and efficiency for children with mild spastic diplegia (cerebral palsy)? Design: Randomised, controlled trial with blinded outcome assessment. Setting: Home-based rehabilitation program with laboratory-based assessments, in Taiwan. Participants: Twenty-four children aged between 5 and 12 years with spastic diplegia cerebral palsy (classified by the Gross Motor Function Classification System (GMFCS) as level I or II) were recruited from hospitals and schools in Taipei and randomly allocated to either the experimental or control group, with stratification by age and GMFCS level. Interventions: Both groups received their regular physical therapy (passive range of motion exercises, positioning, balance, functional, and neurodevelopmental training). In addition, the experimental group underwent loaded sit-to-stand exercise three times a week for six weeks. This group also completed an exercise diary. Outcome measures: Goal dimension scores of the Gross Motor Function Measure (GMFM), gait speed, the maximum load that could be raised during one sit-to-stand manoeuvre, and isometric strength of knee extensors were measured before and after the training period. The physiological cost index (PCI) (the rise in heart rate with walking divided by the walking speed) was also recorded as an index of energy consumption during walking. Results: Twenty children completed the study. At the end of the six-week training period, the GMFM goal dimension scores in the experimental group were significantly better than those in the control group, by 1.17% (95% CI 0.18 to 2.07). Similarly, the maximum load that could be raised during one sit-to-stand manoeuvre was 1.78 kg (95% CI 0.68 to 2.73) higher in the experimental group. Walking efficiency also showed a significant treatment benefit, with the PCI being 1.34 beats/m (95% CI 0.32 to 2.25) lower in the experimental group. There was no significant difference in gait speed and knee extensor strength between the groups. Conclusion: A six-week home exercise program of low-load sit-to-stand resistance exercise can significantly improve basic motor abilities and functional muscle strength, and decrease energy consumption during walking in some children with mild spastic diplegia cerebral palsy.

Commentary

Our field has finally moved beyond the concern that strengthening is harmful for those with spasticity to a more productive approach of identifying more effective resistance training protocols. The authors propose correctly that functionally-based activities in general have greater potential to improve activity and participation. The study design is exemplary in the stratified randomisation scheme, blinding of the assessor to reduce bias, establishing reliability of measures, and power estimation.

A significant positive effect of the loaded sit-to-stand program on the GMFM and PCI was demonstrated. The maximum load that could be raised during one sit-to-stand manoeuvre increased but strength in the targeted knee extensor muscles did not. This suggests that the maximum load that could be raised during one sit-to-stand manoeuvre, while reliable, may not be a valid surrogate measure for knee extensor strength. Literature supports only a moderate relationship between sit-to-stand and knee extensor strength, because this task requires substantial strength in other muscles, eg hip extensors, and also involves balance, movement speed, and sensory perception (Lord et al 2002) all of which may be impaired in cerebral palsy.

Neural changes are prominent early in training which may also partly explain the seemingly disparate strength results. Strength increases can occur within 6 weeks (Dodd et al 2002), so either the load here was not sufficient to adequately stress the knee extensors or their strength was not the factor limiting task performance. It is possible that ankle or hip extensors were strengthened by the training; however, this was more an endurance protocol (multiple repetitions at moderate load until fatigued), than a strengthening one. Direct measurement of fatigue resistance of the knee extensors was not done here, but a change in overall endurance was supported indirectly by the change in PCI.

This rigorously designed study demonstrated improvement in motor activity, beyond the training task, that did not result from an increase in knee extensor strength. Functional training has less specificity in its physiological effects since it addresses multiple impairments, but greater specificity in producing changes in activity since this often requires more than strength increases alone.

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References

Group training reduces the risk of pregnancy-related lumbopelvic pain

Synopsis


**Question:** Does group exercise prevent lumbopelvic pain during and after pregnancy? **Design:** Randomised controlled trial. **Setting:** A University hospital clinic and three outpatient physiotherapy clinics in Norway. **Participants:** Three hundred and one healthy, nulliparous women at 20 weeks of pregnancy. Pregnancy complications and high risk for preterm labour were exclusion criteria. **Interventions:** Subjects were randomly allocated to a training group or a control group. Those in the training group attended a 60-minute weekly group exercise session for 12 weeks. Exercises were supervised by a physiotherapist and included low-impact aerobics, strengthening of pelvic floor, transversus abdominus, and upper/lower limb muscles, and stretches. Daily pelvic floor exercises at home were encouraged. Women in the control group were provided with usual GP or midwife care and were not discouraged from exercising. **Outcomes:** Outcomes were assessed at 36 weeks of pregnancy and three months after birth. Lumbopelvic pain was measured by self-report of pain in the lumbar spine, sacroiliac joints, or pubic symphysis ≥ once per week. Sick leave was measured by self-reported absence from work due to pain in pelvic girdle or lower back. **Results:** At 36 weeks of pregnancy, women in the training group were less likely to report lumbopelvic pain (absolute risk reduction 12.2%, 95% CI 1.0 to 23.3%). Three months after delivery the absolute risk reduction was 10.2% (95% CI –0.2 to 20.5%). The numbers needed to prevent lumbopelvic pain were one in eight women during pregnancy and one in 10 women after delivery. There was no significant difference between groups in self-reported sick leave at 36 weeks (absolute risk reduction 3.9%, 95% CI –5.6 to 13.2%). Compliance in the training group was high (81%). **Conclusion:** This study provides evidence that a 12-week physiotherapy exercise program provides a clinically worthwhile reduction in the risk of pregnancy-related lumbopelvic pain.

Commentary

Lumbopelvic pain related to pregnancy is a widespread problem that results in sick leave for a number of women and may persist for years after pregnancy and delivery (Albert et al 2001). Few studies have examined interventions to prevent pregnancy-related lumbopelvic pain (Stuge et al 2003). This paper addresses an important question often raised by patients and health care practitioners.

The current study concluded that group training during pregnancy was effective, as pain was prevented in one in eight women during pregnancy. This conclusion is based on one outcome: the presence of lumbopelvic pain once per week or more. A reduction in the intensity of pain would have further strengthened this conclusion. Also the effect was reduced three months postpartum with a risk difference in reporting lumbopelvic pain of 10%. There was no difference in sick leave between the groups, but there were very low levels of disability in both groups postpartum. Hence, there is reason to question whether this study provides evidence of a clinically worthwhile reduction in the risk of pregnancy-related lumbopelvic pain *per se*.

Furthermore, the main focus of the intervention was on pelvic floor muscle strength with additional general exercises. Interestingly, no association between pelvic floor muscle strength and lumbopelvic pain was found. Low back pain is stated to differ from pelvic girdle pain, and subgroups of pelvic girdle pain may exist (Albert et al 2001, O’Sullivan and Beale 2007a). Subgroups of patients may need different interventions (O’Sullivan and Beale 2007b), thus there is a possibility that group exercises may not be optimal either in preventing or treating lumbopelvic pain.

Given that the group training in this study reduced urinary incontinence (Mørkved et al 2003), the elimination of lumbopelvic pain for one in eight women can be seen as a welcome bonus. In light of current knowledge, including this study, one may still question whether other approaches could provide more optimal prevention and treatment of lumbopelvic pain in this population.

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References

Noninvasive ventilation before and after lobectomy reduces pulmonary dysfunction and length of hospital stay

Synopsis


**Question:** Does prophylactic use of noninvasive ventilation (NIV) before and after elective lobectomy affect post-operative oxygenation, pulmonary function, atelectasis, and length of stay in hospital? **Design:** Randomised, controlled trial with concealed allocation and blinded assessment of some outcomes. **Setting:** Surgical unit of a tertiary hospital in France. **Participants:** Adults with lung cancer and lung function < 70% of the predicted value who were scheduled for elective lobectomy via posterolateral thoracotomy. Thirty-nine patients were randomised one week preoperatively to a NIV group (n = 22) or a control group (n = 19). **Interventions:** Both groups received standard postoperative care, including at least four days in the surgical intensive care unit and epidural analgesia. In addition, the NIV group used bilevel positive airway pressure for five one-hour periods daily from seven days prior to surgery until three days after surgery. During an initial one-hour acclimatisation period, the inspiratory positive airway pressure (IPAP) was titrated up from 8cmH\textsubscript{2}O to the maximum tolerated, and the expiratory positive airway pressure (EPAP) was set at 2 to 4cmH\textsubscript{2}O. **Outcome measures:** Arterial blood gases (pH, PaO\textsubscript{2}, PaCO\textsubscript{2}) and lung function (FEV\textsubscript{1}, FVC) were measured at enrolment, after the seven days of preoperative NIV, two hours postoperatively, and daily until the third day after surgery. Chest radiographs performed two hours postoperatively and daily until the third day after surgery were assessed by radiologists for the presence of lobar atelectasis. The duration of hospital stay, opioid use, and pain and dyspnoea scores were also recorded. **Results:** Thirty-two participants completed the study. One patient in the control group required invasive ventilation for total pneumothorax immediately postoperatively and was excluded from the analysis. Six patients in the NIV group were excluded from the analysis because the surgical procedure was changed. Compared to the control group, arterial blood gases were significantly better in the NIV group after the seven days of pre-operative NIV and remained significantly better at all or most of the post-operative measurement points. Similarly, lung function was significantly better in the NIV group at most of the postoperative measurement points. Incidence of lobar atelectasis was not reduced significantly, with the number needed to treat to prevent one case of atelectasis estimated at 4 (95% CI 2 to 14). The duration of hospital admission was significantly reduced, by 7 (95% CI 5 to 9) days. Opioid use did not significantly differ between the groups, while pain and dyspnoea scores were not reported. **Conclusion:** Prophylactic use of NIV pre- and postoperatively significantly reduces pulmonary dysfunction and length of hospital stay after elective lobectomy. [NNT, 95% CIs, and statistical power calculated by the CAP Co-ordinator]

Commentary

Despite lung cancer being the fourth leading cause of cancer death in Australia (AIHW 2007), little research is available investigating interventions to improve outcomes following lung resection. The current study highlights improvements in short-term physiological outcomes and hospital length of stay (LOS) in thoracic surgical patients receiving both pre- and postoperative NIV.

Whilst the reported reduction in the LOS is clinically important, the management outlined in this study is not representative of practice in Australian tertiary hospitals. Most patients return directly to the ward postoperatively rather than spend four days in a surgical ICU. In addition the LOS in the control group of 19 ± 3 and intervention group of 12 ± 1 is higher than mean data reported in similar populations: Spain < 10 days (Varel et al 2006); New Zealand unpublished audit of 50 patients 7 ± 3 days.

Atelectasis can be associated with development of several pathophysiological effects including impairment in oxygenation. The study did not identify a statistically significant effect of NIV on the incidence of atelectasis, but statistical power for this outcome was low (calculated retrospectively at 33%). The confidence interval includes effect sizes that would be considered clinically worthwhile, so the effect on atelectasis could be investigated further. Pre-rehabilitation is an emerging concept although few have studied NIV for this purpose. However, in the current study the more significant responses to NIV occurred in the postoperative period and these changes are consistent with those found in previous research (Auriant et al 2001).

Using international classification systems to categorise FEV\textsubscript{1} would allow assessment of the response to NIV in relation to the severity of airway obstruction. The timing of measurement of FEV\textsubscript{1} and FVC in relation to pain scores post-operatively would have been useful inclusions in the paper, as spirometry is effort dependent.

Despite these clinical reservations, this study raises the issue of prophylactic use of NIV in surgical populations.

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**References**


Exercise slows functional decline in nursing home residents with Alzheimer’s disease

Synopsis


Question: Does a regular exercise program improve the ability of nursing home residents with Alzheimer’s disease to perform activities of daily living (ADL)? Design: Randomised, controlled trial with concealed allocation and blinded outcome assessment. Setting: Five nursing homes in France. Participants: Nursing home residents with Alzheimer’s disease who were able to transfer from a chair and walk six metres without assistance. Vascular dementia, Parkinson’s disease, and cardiac conditions contraindicating exercise were exclusion criteria. Randomisation of 134 participants allotted 67 to an exercise training group and 67 to a control group. Interventions: Both groups received routine management, including nursing, physiotherapy and medical care. In addition, the exercise training group participated in a one-hour group exercise session twice per week for one year. At least half of each session consisted of walking at an intensity intended to induce moderate breathlessness. The walking course passed the room of each member of the exercise group. The remainder of the session included strength, flexibility, and balance training. The control group received no exercise or behaviour management training. Outcome measures: The primary outcome was the change in Katz ADL score at the end of the 12-month training period. The Katz ADL score is the sum of scores for six activities, each scored as 0 for requiring complete help, 0.5 for requiring little help, and 1 for independent. Secondary outcome measures were the Katz ADL score at 6 months, 6-metre walking speed, the get-up-and-go test, the one-leg balance test, and indices of nutrition, behavioural disturbance, and depression. Results: One hundred and ten participants completed the study. At the end of the one-year training period, the deterioration in Katz ADL score was significantly less in the exercise group, by 0.4 (95% CI 0.1 to 0.7). At 6 months, the ADL scores did not differ significantly. Walking speed improved significantly more in the exercising than in the control group at 6 months (by 0.04 m/sec) (95% CI 0.01 to 0.07) and at 12 months (by 0.05 m/sec) (95% CI 0.02 to 0.08). The groups did not differ significantly on the remaining secondary outcomes. Conclusion: As an adjunct to standard care, a one-year exercise program significantly slows the decline in the ability of nursing home residents with Alzheimer’s disease to perform ADLs independently.

[95% CIs calculated by the CAP Co-ordinator]

Commentary

This study adds to a growing literature on the role of physical activity in the management of patients with dementia. A recent meta-analysis (Heyn et al 2004) of randomised, controlled trials reported beneficial effect sizes (ES) of physical activity on (physical) function (ES = 0.59), cognitive function (ES = 0.57), and behavioural outcomes (ES = 0.54) in adults with dementia. This literature is notable for randomised trials which, like that of Rolland et al, find beneficial effects at relatively low doses of physical activity. For example, a randomised trial by Teri et al (2003) in community-living adults with dementia prescribed at least 150 minutes of physical activity each week, but at 3 months follow-up just 56% of participants exercised more than 60 minutes per week. Even so, the study reported that physical activity had beneficial effects on physical function and depression. The meta-analysis by Heyn also showed that even though some studies use relatively low doses of exercise, adults with dementia show measurable improvements in fitness with exercise (Heyn 2004). Of course, it can be challenging to engage adults with dementia in regular exercise, and exercise has risks. Most risks relate to injuries which can impair physical function. Hence the results of this study and the results of the meta-analysis are reassuring – not just to the feasibility of exercise in adults with dementia, but also to the risk benefit ratio. Whatever injuries might occur with exercise to impair function, the net effect of exercise on function and disability appears to be beneficial.

The broader context of the study by Rolland et al is the growing evidence that physical activity has beneficial effects on cognition in humans, as recently summarised in a review by Kramer et al (2006). My analysis of this literature is that public health guidelines for physical activity already recommend physical activity at the levels associated with improved brain health. Clinicians should emphasise the importance of regular physical activity to their patients for many reasons, including the probable beneficial effect of physical activity on brain health.

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[The opinions expressed in this article are those of the author and do not necessarily represent positions or policies of the Centers for Disease Control and Prevention.]

References