

## Is progressive resistance exercise ineffective in increasing muscle strength in young people with cerebral palsy?

What is surprising and challenging about the systematic review of Scianni et al (2009) is the finding that strengthening interventions, including progressive resistance exercise, are ineffective in increasing muscle strength in young people with cerebral palsy. This finding is surprising as it is contrary to the conclusions of previous systematic reviews that progressive resistance exercise is effective in increasing muscle strength in people with cerebral palsy (Dodd et al 2002), and across diverse populations in physiotherapy practice (Taylor et al 2005). The finding is challenging because if an intervention does not achieve its primary purpose, in this case to increase muscle strength, then further discussion about whether the intervention can affect more meaningful things, like the ability to carry out daily tasks, is meaningless.

One explanation for this apparently contrary finding is that the review of Scianni et al (2009) only included controlled trials, whereas the review of Dodd et al (2002) included studies with single group pre-post designs, designs that are more subject to bias. Therefore, it is possible that the review of Dodd et al (2002) may have overestimated the true effect of progressive resistance exercise.

A second consideration, acknowledged by the authors of the review, is whether the interventions provided a sufficient stimulus to provide a strengthening effect. One of the three included trials that evaluated resistance exercise, that of Liao et al (2007), reported that participants completed between 20 and 100 repetitions of their sit to stand exercise (at a load of 50% of one repetition maximum) during each session. Such a dosage is not consistent with guidelines for increasing muscle strength: that the load should be such that no more than 8 to 12 repetitions can be completed before muscular fatigue (American College of Sports Medicine 2002). The training dosage described by Liao et al (2007) is more consistent with a dosage designed to practise a skill or increase muscle endurance, but not to increase muscle strength. Also, two other trials included in the analysis of muscle strength by Scianni et al (2009) investigated the application of electrical stimulation. The authors of those trials questioned whether the intensity of the stimulation was sufficient to achieve a strengthening effect. Therefore, there are questions about whether three of the five trials included in the analysis of muscle strength provided an intervention with sufficient intensity to increase muscle strength. Also, because the five trials included in the analysis on muscle strength included three distinct interventions (progressive resistance exercise, endurance training, and electrical stimulation) is it reasonable to combine them in a meta-analysis?

A third consideration concerns the method of calculating effect sizes (standardised mean differences) and whether this led to some anomalous findings. Scianni et al (2009) calculated effect sizes on post-intervention means according to the recommend method (Higgins and Green 2008).

For McCubbin and Shasby (1985), the effect size estimated on the post-intervention means was 0.69 (95% CI -0.21 to 1.63), indicating a non-significant effect. This is in contrast to the author's original report of a significant effect in favour of progressive resistance exercise, and data that the intervention group increased strength by 58.9% and the control group reduced strength by 5.3%. So what is going on? Calculation of effect sizes based on changes from baseline on the same data results in an effect size of 1.63 (95% CI 0.62 to 2.64). Similarly, re-calculation of the effect size based on changes from baseline for Dodd et al (2003) results in an effect size of 0.74 (95% CI -0.15 to 1.63), in contrast to an effect size of 0.07 (95% CI -0.79 to 0.93) if calculated on post intervention means. The main point is that the same data in controlled trials with very small sample sizes (the two trials described here only included a total of 21 participants in the strengthening groups) can lead to very different estimates of effect according to the method chosen.

A hallmark of good research is to raise questions and challenge accepted practice. Scianni et al (2009) are congratulated for completing a high quality systematic review that raises questions and challenges the use of progressive resistance exercise, and other strengthening interventions, as a treatment option for young people with cerebral palsy. However, given the questions about whether the interventions were applied with sufficient intensity, whether it is reasonable to combine interventions with clinical heterogeneity in a single meta-analysis on the effects on muscle strength, and given questions about how the method of calculation of effect sizes on the same data can result in very different interpretations, is it reasonable to conclude, as the authors have done in the title of their review, that muscle strengthening is not effective in children and adolescents with cerebral palsy?

**Nicholas F Taylor**

*La Trobe University, Australia*

### References

- American College of Sports Medicine (2002) *Med Sci Sports Exerc* 34: 364–380.
- Dodd KJ et al (2002) *Arch Phys Med Rehabil* 83 (8): 1157–1164.
- Dodd KJ (2003) *Dev Med Child Neurol* 45: 652–657.
- Higgins JPT, Green S (Eds) (2008) *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.0.1 Available from [www.cochrane-handbook.org](http://www.cochrane-handbook.org).
- Liao HF et al (2007) *Arch Phys Med Rehabil* 88: 25–31.
- McCubbin JA, Shasby GB (1985) *Adapt Phys Activ Q* 2: 56–64.
- Scianni A et al (2009) *Aust J Physiother* 55: 81–87