Muscle strengthening is not effective in children and adolescents with cerebral palsy: a systematic review

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CRD summary

This high-quality review found that strengthening interventions did not improve strength or activity and did not appear to increase spasticity in children with cerebral palsy. The review was limited by a relatively small number of studies. The possibility of studies being missed from the review means that the results should be interpreted with caution.

Authors' objectives

To examine whether muscle strengthening interventions can increase strength (with or without increasing spasticity) and/or improve activity in children and adolescents with cerebral palsy and whether benefits are maintained beyond the length of the intervention.

Searching

MEDLINE (from 1966), CINAHL (from 1982), EMBASE (from 1974) and PEDro were searched to July 2008. Reference lists of retrieved studies were screened. Broad search terms were listed in the review; the search strategy was available online. No language restrictions were applied.

Study selection

Randomised, quasi-randomised and controlled trials of any strengthening intervention in children aged four to 19 years with spastic cerebral palsy were eligible for inclusion. Participants who had botulinum toxin A treatment or surgery in the previous six months were excluded. Interventions had to involve effortful, strong and repetitive muscle contractions. It had to be stated or implied that the intervention was progressed as ability changed. Comparison interventions were no treatment, placebo or an alternative therapy, where the intervention was muscle strengthening plus that therapy. Outcome inclusion criteria were measures of muscle strength.

In the included studies, mean age (where reported) ranged from 7.4 to 13.1 years. Participants had mild to severe disability. Interventions included progressive resistance exercise, electrical stimulation or loaded sit-to-stand exercises for ankle, knee, elbow or hip joints. Interventions were given between three and six times per week for between six and 16 weeks. Control groups received no intervention, usual physiotherapy or placebo. Follow-up ranged from six to 22 weeks.

One reviewer identified potentially relevant papers; two reviewers, blinded to the authors journal and outcomes, independently reviewed the methods of full papers. Disagreements were resolved by a third reviewer.

Assessment of study quality

Validity scores were based on PEDro scores from Physiotherapy Evidence Database. Scores were assigned independently by two raters; disagreements were resolved by a third. For studies not on the database, PEDro scores were assigned independently by two authors who had completed appropriate training.

Data extraction

Data were extracted by one reviewer and checked by a second.

Where several outcome measures were reported, the measure that reflected the body part to which the intervention was applied was included. When both limbs were trained, the more affected limb was used in the analysis. When more than two interventions were studied, the intervention chosen was the one that targeted more muscles; for the control, placebo was chosen over no intervention if the placebo was convincing. Post-treatment mean and standard deviation were used to calculate mean differences or standardised mean differences (SMD), depending on whether the same methods of measurement were used.

Interventions were categorised as electrical stimulation, biofeedback or progressive resistance exercise. Examples of each are given in the review. Continuous and ordinal measures of strength, spasticity and activity were extracted.

Severity of disability was recorded using the Gross Motor Function Recording System (if reported) of the National Association of Sport for Cerebral Palsy.

Methods of synthesis

A random-effects model was used to compute weighted mean differences (WMD) or Cohen's standard mean differences (SMD) with 95% confidence intervals (CI). Statistical heterogeneity was measured using the I^2 statistic. Post hoc subgroup analyses of upper versus lower limb training, length of intervention and type of intervention was performed to investigate clinical heterogeneity.

When data were not able to be included in the pooled analysis, the outcome of the between-group analysis was reported.

Results of the review

Five randomised controlled trials (RCTs) (n=135 participants) and one quasi-randomised trial (n=30 participants) were included in the review.

The studies were of moderate quality (mean PEDro score 5.5 from a maximum possible 8). Allocation was concealed in two studies (33%). Assessors were blinded in three studies (50%). More than 15% of participants dropped out in three studies (50%). Intention-to-treat analysis was carried out in two studies (33%).

The intervention had a non-significant beneficial effect on strength immediately after the end of the training period (SMD 0.20, 95% CI -0.17 to 0.56; five studies, n=119 participants). There was no evidence of heterogeneity (I^2<30%). Six to 12 weeks after cessation of training, the intervention had no effect on strength (SMD 0.05, 95% CI -0.47 to 0.58; two studies, n=56 participants).

Data from the one study that reported on spasticity could not be extracted.

The interventions had no effect on walking speed (four studies) and a small beneficial effect on activity (two studies). There was an increase of 2% on the Gross Motor Function Measure (95% CI 0 to 4%). This effect was retained but no longer significant six to 12 weeks after the cessation of training (2% increase, 95% CI -4 to 7).

Subgroup analyses showed that neither type of intervention nor the part of the body made a difference to the size of the effect.

Authors' conclusions

Strengthening interventions improved neither strength nor activity in cerebral palsy and did not appear to increase spasticity, although evidence for the latter were sparse.

CRD commentary

The review addressed a clear question. Participant, intervention, study design and outcome inclusion criteria were all clearly stated. Multiple databases were searched and it was likely that relevant published studies were identified. No attempt was made to search for unpublished data. No assessment of publication bias was made, so it was not possible to comment on the likelihood of publication bias. Titles and abstracts were screened by only one reviewer, so there was a possibility of error and bias at this stage. Subsequent steps of the review process were performed in duplicate, which reduced the chance of errors. The validity assessment was performed using appropriate criteria and was clearly presented, although validity data in the table were not fully consistent with the text. The meta-analysis was appropriate.

The authors' conclusions are likely to be reliable based on the presented data, but some caution should be maintained due to the possibility that some studies were not included in the review.

Implications of the review for practice and research

Practice: The authors stated that muscle strengthening exercises were unlikely to be beneficial in children and adolescents with cerebral palsy who were walking, but were probably not harmful.

Research: The authors stated that further studies could be useful to inform clinical practice.

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