A systematic review of the effectiveness of strength-training programs for people with cerebral palsy

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Authors' objectives
To determine whether strength training is beneficial for people with cerebral palsy (CP).

Searching
MEDLINE (via PubMed), EMBASE, CINAHL, SPORTDiscus, DARE, PsycINFO, ERIC, AusportMed, AMI, the Cochrane Library and PEDro were searched from their inception to 2000, using the keywords 'cerebral palsy' in combination with 'exercise', 'strength' and 'physical training'. The search was limited to publications in the English language. In addition, the reference lists of identified articles were examined and the related articles link on PubMed was used to identify further relevant articles.

Study selection
Study designs of evaluations included in the review
No restriction was used for study design. However, only empirical studies with a PEDro score of three or more (see 'Criteria for assessing the validity of primary studies' section) were included and the reviews had to meet at least one of the following criteria: sources of primary studies were identified; the process used for selecting studies for detailed review was reported; and the criteria for assessing the quality of studies were detailed. The reviews also had to be based on at least five key articles to be considered.

Specific interventions included in the review
Only studies that looked at an exercise programme that used strength training or progressive resistance were considered for inclusion. Most of the included studies examined exercise programmes that were administered to individuals, rather than a group programme. The exercise programmes included the use of free weights, fixed weights, isometric and isokinetic pulley weights, or a concentric and eccentric with or without isokinetic programme. Most of the exercise programmes were performed 3 times per week over 6 to 10 weeks.

Participants included in the review
Studies of adults or children with CP were considered for inclusion. The severity of the disability of the participants recruited to the included studies varied considerably. They included participants who were ambulatory with or without a gait device, had a CP International Sports and Recreation Association Classification System (CP-ISRA) score of 5 or 6, CP-ISRA score 7 or 8, or a mixture of the National Association of Sports for CP Classification System (NASCP). The topographic classification also varied between the included studies, but most participants had spasticity. The participants' age ranged from 4 to 47 years.

Outcomes assessed in the review
Only studies that reported the following outcome measures were considered: changes in strength, activity, or participation.

How were decisions on the relevance of primary studies made?
The studies were assessed by two reviewers independently, with any disagreement being resolved by consensus. Inter-observer agreement was assessed using the weighted kappa statistic.

Assessment of study quality
The methodological quality of the empirical studies was assessed using the PEDro scale, while review articles were assessed using the Centre for Reviews and Dissemination form. With the PEDro scale the following indicators were scored as present or absent: specification of eligibility; random allocation; concealed allocation; prognostic similarity at baseline; participant blinding; therapist blinding; assessor blinding; greater than 85% follow-up for at least one key
outcome; intention-to-treat analysis; between-group statistical analysis for at least one key outcome; and point estimates of variability provided for at least one key outcome. The last ten indicators were used to give each study a score of between 1 and 10. The studies were assessed by two reviewers independently, with any disagreement being resolved by consensus. Inter-observer agreement was assessed using the weighted kappa statistic.

**Data extraction**
Data from the included studies were summarised on standardised forms. It was not stated how many of the reviewers performed this data extraction. The contextual factors of particular interest were: whether the programmes were administered in groups or to individuals; whether the programme was administered in a community, laboratory, or clinical environment; and whether the cognitive function of the participants was considered. For each study, the summary effect sizes (difference in the means (pre- and post-test) divided by the standard deviation, SD, of the difference) were calculated, along with the 95% confidence intervals (CIs). Since the SD cannot be calculated without access to the raw data, an approximation was made by relating the SD of the difference in the means to the correlation between the two sets of data. Estimates of the reliability between pre- and post-test strength measurements were obtained from the articles that provided sufficient raw data.

**Methods of synthesis**
How were the studies combined?
The studies were combined in a narrative summary.

How were differences between studies investigated?
Differences between the studies were investigated through a narrative summary. The summary effect size and 95% CIs of the individual studies were also presented in forest plots.

**Results of the review**
Eleven studies (10 empirical with 130 participants, and 1 review) were included. Of the 10 empirical studies, one was a randomised controlled trial (RCT) and 9 were observational studies that used a repeated-measures, single-group design. Six of the observational studied had no control data with which to evaluate the effects of strengthening exercise on participants with CP.

The median PEDro score for empirical studies was 4 (interquartile range 3 to 5).

Changes in strength (10 empirical studies, 15 comparisons): 8 studies (11 comparisons) reported strength increases as a result of the strength-training programme, with effect sizes ranging from 1.16 (95% CI: 0.11, 2.21) to 5.27 (95% CI: 4.69, 5.85).

Activity (4 studies, 7 comparisons): 2 studies (2 comparisons) reported improvements in activity, with effect sizes ranging from 1.0 (95% CI: 0.33, 1.67) to 1.22 (95% CI: 0.18, 2.26).

Participation: none of the 10 studies measured the effect of a strengthening programme on participation limitation.

Other outcome measures: one study reported an improvement in self-perception.

No negative effects, such as reduced range of motion (4 studies) or spasticity (2 studies), were reported. There was insufficient evidence from which to draw conclusions about the effects of environmental and personal contextual factors.

Results of the included review: one RCT and 6 case series (without concurrent or historical controls) were included, all of which reported positive results on strength increases; none reported negative effects. The authors concluded that the relationship between strength gains and improvement in function remained unclear.

**Authors' conclusions**
The results of the review suggest that training can increase strength and may improve activity in people with CP, without adverse effects. More rigorous studies are needed that have a greater focus on changes in activity and participation, and that consider contextual factors.

**CRD commentary**
This review addressed an appropriate question using clear inclusion and exclusion criteria. The literature search was comprehensive but did not include a search for unpublished data. A systematic process involving two or more reviewers was used to select the papers for inclusion and to assess the study quality. However, it was not stated how many of the reviewers performed the data extraction, or whether the data were checked for accuracy. One RCT was included; however, it was not stated what the control had entailed and the results of the trial were presented as if it was an uncontrolled study, i.e. in the same way as the other included studies. The results of the controlled comparison were not reported for any of the included studies. Differences between the included studies were discussed in the text and the results were presented in forest plots. In view of the differences, the authors’ decision not to pool the data was appropriate. The authors’ conclusions follow from the results presented.

**Implications of the review for practice and research**
**Practice:** The authors did not make any recommendations for practice.

**Research:** The authors state that there is a need for further well-designed RCTs to evaluate the effects of strength training in the CP population.

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**Record Status**
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.