A systematic review of the effectiveness of treadmill training for children with cerebral palsy

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CRD summary
The review found that treadmill training with body weight support appeared safe and feasible for children with cerebral palsy and various functional abilities. It may improve walking speed and motor skills, but more research was required. The review was generally well conducted and the authors’ cautious conclusions appeared to reflect the limited evidence base.

Authors' objectives
To assess the effectiveness of treadmill training for improving gross motor function and societal participation in children with cerebral palsy.

Searching
The Cochrane Library, PEDro, MEDLINE, CINAHL, EMBASE, ERIC, PsycINFO, AMED, Ausport Med, SPORTDiscus and Web of Science were searched to July 2008. Search terms were reported. Reference lists of relevant articles were checked. The search was limited to fully published studies in English.

Study selection
Studies of treadmill training for children (under 18 years) with cerebral palsy were eligible for inclusion. Where concurrent interventions were reported, at least 80% of the total intervention was required to be treadmill training. Studies were excluded if the treadmill was used for assessment only, if participants had physical or cardio-respiratory disorders that might impact on the intervention and if more than 20% of participants did not have cerebral palsy.

Mean age of participants in included studies was 4.5 to 11.5 years. Most were male. Participants had a range of disorders (such as spastic diplegia, athetoid quadriplegia and hemiplegia) of varying severity (Gross Motor Function Measure score range was 1 to 4, where reported). Treadmill training was physiotherapist-supervised and administered for two to 12 weeks, usually for about 30 minutes two or three times a week. All studies included gait training and used partial body weight support via a variety of systems with differing levels of support. Training intensity was increased by reducing body weight support and/or increasing treadmill time or speed. One study described using motivational tools to encourage training. Review outcomes included walking, gross motor skills, body structure and function and adverse events. No studies reported societal participation. Settings included outpatient facilities and a school gymnasium.

Two reviewers independently selected the studies. Disagreements were resolved by discussion.

Assessment of study quality
Study validity was assessed with the PEDro scale of up to 10 points for randomisation, allocation concealment, group comparability at baseline, blinding, outcomes measurement, use of intention-to-treat (ITT) analysis, follow-up and statistical reporting. Studies that scored fewer than 3 points were excluded.

Two reviewers independently assessed validity. Disagreements were resolved by discussion.

Data extraction
Effect sizes were calculated from difference in mean scores at follow-up between the two groups (in controlled studies) or difference between pre- and post-intervention scores (in single-group studies) and their standard deviations. Effect sizes were designated small (under 0.20), medium (0.20 to 0.80) or large (over 0.80), using Cohen's convention.

Two reviewers independently extracted the data. Disagreements were resolved by discussion. Primary study authors were contacted for more information if required.
Methods of synthesis
Studies were combined in a narrative synthesis organised by outcomes.

Results of the review
Five studies were included (n=48, range six to 19): one controlled study with matched pairs (n=8); and four before-and-after studies (n=40), one of which had a relevant control group. Study quality was low (median PEDro score 4 points, range 3 to 6). None of the studies used allocation concealment and only one used blinded outcomes assessment.

In two studies the intervention improved self-selected walking speed over 10 metres, with large effect sizes; however, the effect was statistically significant in only one study (1.48, 95% CI 0.49 to 2.4; n=14). A third study reported a significant increase in walking speed over 10 metres. A fourth study reported a large but non-significant effect from the intervention among more severely affected children (effect sizes not calculable). Studies reported no statistically significant effect on walking endurance (two studies) and physical support required to achieve functional ambulation (two studies).

All four relevant studies reported an improvement from the intervention in Dimension E of the Gross Motor Function Measure, with a large effect in two studies; however, the effect was statistically significant in only one case (1.52, 95% CI 0.52 to 2.51; n=10). Two of three relevant studies reported an improvement in Dimension D, one with a large effect size (1.00, 95% CI 0.07 to 1.93; n=10). One study reported a significant improvement in overall Gross Motor Function Measure score, which was retained for at least 12 weeks post-intervention.

One study reported that the intervention improved energy expenditure, with a large effect of borderline statistical significance. A second study reported no significant improvement in muscle tone or selective motor control.

All studies reported that training was well tolerated by participants.

Authors’ conclusions
Treadmill training with body weight support appeared safe and feasible for children with cerebral palsy with a variety of functional abilities. It may improve walking speed and motor skills, but more research was required.

CRD commentary
The objectives and inclusion criteria of the review were clear and relevant sources were searched for studies. The restriction to published studies in English meant that the review was potentially subject to language and publication biases. [A: However, as the literature search did not locate any papers published in languages other than English, none were excluded on this basis]. Steps were taken to minimise the risk of reviewer bias and error by having more than one reviewer independently undertake study selection, validity assessment and data extraction. The decision to combine studies by narrative synthesis was appropriate in view of differences between studies. Methodological quality was assessed and the authors took account of study quality in their interpretation. However, summary scores were used to select studies for inclusion. Use of summary quality scores is not generally recommended and a more valid approach would have been to include all relevant studies and assess the impact of individual quality criteria on the results of any analyses. There was some discrepancy between the text and table of results in reporting of the statistical significance of findings (results reported in tables and figures were used in this abstract). There were few included studies and sample sizes were small. Study quality was poor and there was wide variation in study methodology and participant characteristics.

The review was well conducted in most respects and the authors’ cautious conclusions adequately reflected the limited evidence.

Implications of the review for practice and research
Practice: The authors stated that treadmill training with body weight support appeared to increase self-selected walking speed over short distances among children with cerebral palsy, especially those with more severe functional involvement. Clinicians should consider matching treadmill-training parameters with treatment goals and consider accessibility issues when determining intensity of training.
Research: The authors stated that well-powered studies should examine the effect of treadmill training on children with specific levels of walking disability. Optimum level of body weight support and optimum intensity and duration of training needed to be determined. Outcomes should include impact on societal involvement and on body structure and function.

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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.