A systematic review of the effectiveness of treadmill training and body weight support in pediatric rehabilitation

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CRD summary
The authors concluded that available evidence demonstrates the efficacy of body weight-supported treadmill training in children with Down syndrome. Evidence of efficacy or effectiveness in paediatric spinal cord injury and cerebral palsy was very limited. The reliability of the conclusions was limited by the weak strength of the available evidence (small sample sizes and limited randomised controlled trials).

Authors' objectives
To explore the strength, quality and conclusiveness of evidence supporting use of treadmill training and body weight support in patients with paediatric motor disabilities.

Searching
MEDLINE, EMBASE, CINAHL Plus, PEDro, The Cochrane Library and ERIC were searched from January 1980 to May 2008. Search terms were reported. Only studies published in English were considered. Reference lists of identified articles were handsearched.

Study selection
All studies that assessed treadmill training and body weight-supported gait training used separately or in combination for individuals less than 21 years with or at risk of a motor disability affecting gait coordination or function were eligible for inclusion. Studies that included participants 21 years or older were only considered if they reported individual data or separate data or separate analyses for individuals less than 21 years. Studies with coninterventions were considered. Studies were eligible only if they focused on improving aerobic fitness or decreasing body weight through greater caloric expenditure. Other eligibility criteria were: studies that were of typically developing children; studies that used treadmills for sports-related training; and studies that addressed diminished exercise capacity because of asthma, cystic fibrosis, obesity or acute medical illness. Studies that investigated only within-session effects of different walking conditions were excluded.

Most studies included body weight support and treadmill in combination (not all treadmill studies included use of body weight support for all participants). Participants were categorised as having cerebral palsy or other central motor impairments, spinal cord injuries and Down syndrome. Locomotor training protocols varied across studies, as did settings (in-patient, outpatient, school and home), participant ages and mobility levels (full details reported in the paper).

Two authors independently selected studies for inclusion; disagreements were resolved by discussion.

Assessment of study quality
Two authors independently rated the strength of evidence using Sackett’s Levels of Evidence (I to V, with I considered the highest level of evidence) and the quality of included studies using the PEDro scale (maximum score 10). Disagreements were resolved by consensus.

Data extraction
Two authors independently extracted data, where reported, on mean scores in the intervention and control groups to calculate mean change and differences in mean change scores. Effect sizes were calculated for the three most common outcome measures (self-selected gait velocity, Gross Motor Function Measure dimensions D and E) in the group with central nervous system impairments by dividing the difference in mean change scores across treatment groups by the standard deviation of the mean change score in the control group or dividing the mean change due to the intervention of interest by its standard deviation. Disagreements were resolved by consensus.
Methods of synthesis
Results were reported in a narrative format grouped by population (cerebral palsy or other central nervous disorders, Down syndrome and spinal cord injuries).

Results of the review
Twenty-nine studies (n=315, range one to 45) were included: seven randomised controlled trials, three controlled non-randomised trials, eight prospective cohort studies, three case series and eight case reports. Strength of evidence of about half of the studies was rated as level IV (using the Sackett Level of Evidence). Quality of evidence of about half of the studies was rated 2 using the PEDro scale (range 2 to 6).

Cerebral palsy and other central nervous system disorders (17 studies): One level 3 non-randomised controlled study found a significant effect on self-selected gait speed compared with control and one level 2 RCT. Some positive outcomes were found in the other studies (evidence level 4 or 5), but overall results were inconsistent.

Down syndrome (six studies): Treadmill training was associated with positive effects on independent walking and a number of quantitative and qualitative aspects of gait performance. There was some evidence to suggest that higher intensity training protocols may have been more effective than less intense protocols. Most studies were RCTs. Most studies used same samples or subsamples.

Spinal cord injuries in children and young adults: Treadmill training was associated with positive outcomes in most of the results and a number showed large and clinically significant changes (such as progression from no ability to step to walking independently with an assistive device by end of training).

Adverse effects: Few studies reported data on adverse effects; none reported occurrence of any episodes that were anticipated and monitored.

Cost information
The authors stated that the high cost of treadmill training programmes may limit availability and duration.

Authors' conclusions
Available evidence demonstrated the efficacy of body weight-supported treadmill training (BWSTT) in children with Down syndrome. Evidence of efficacy or effectiveness of BWSTT in paediatric spinal cord injury and cerebral palsy was very limited.

CRD commentary
The review addressed a clearly stated question with well defined inclusion and exclusion criteria. Several relevant databases were searched. Non-English publications were excluded, which risked language bias. Review processes were conducted in duplicate, which minimised risks of error and bias. The strength of available evidence and study quality were assessed with scale-based criteria and results were used to inform the synthesis. The decision to combine results narratively was appropriate given significant study differences. The authors acknowledged the limitations in the strength and quality of the available evidence. Overall, only a few participants were included.

This was generally a well-conducted review, but the reliability of the authors' conclusions was limited by the weak strength of available evidence (small sample sizes and a limited number of randomised controlled trials).

Implications of the review for practice and research
Practice: The authors stated that further randomised controlled trials with treadmill training-only groups and dosage studies were needed before practice guidelines could be formulated.

Research: The authors stated that further large controlled trials were needed to support the use of body BWSTT in other paediatric subgroups. Increased use of randomised controlled designs for treadmill training-only groups and dosage studies were needed. Studies were needed to investigate the efficacy of treadmill training on developmental and activity-level outcomes (short- and long-term) in children with multiple disabilities. Further larger studies with control groups
were required to determine the efficacy of BWSTT and whether associated resources (equipment, therapist and patient time) were justified.

The authors also recommended studies to explore: neural changes in response to training given the capacity for change in developing nervous systems; the safety of using a treadmill over longer periods for those at risk of joint deformity in the short term (such as fracture and hip dislocation) or at risk of osteoarthritis in young adulthood; use of other lower extremity reciprocal exercise devices (such as cycles, water-based treadmills and elliptical trainers); and ways to transition locomotor training to a home or community-based setting in the rehabilitation process.

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