Body-Weight–Supported Treadmill Training: Using Evidence to Guide Physical Therapy Intervention

Definition

Body-weight–supported treadmill training (BWSTT) is an intervention used by pediatric physical therapists in a variety of practice settings. BWSTT provides a system for working on strength, endurance, and task-specific gait training. During BWSTT, the body weight of the child is unloaded by adult assistance (Figure 1) or by a counter-weight harness system placed over a treadmill (Figures 2 and 3). The legs are advanced actively by the child, with manual assist of a therapist or family/caregiver (Figure 2) or robotically (Figure 3).

Figure 1. Adult Assistance for Body-Weight Support

Figure 2. Litegait Used Over Treadmill With Therapist Assisting to Advance Limbs

Figure 3. Child on the Lokomat With Robotic Assistance to Advance limbs and Therapist Controlling Parameters Through Computer Interface

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Evidence
The rationale for use of BWSTT is supported by current motor learning principles specifying active engagement in task performance over time for neuroplasticity to occur.1 BWSTT allows repetition and intensity of training in the task-specific practice of walking. Numerous research studies specific to the use of BWSTT for children have been published. The majority of studies suggest improvement at the levels of body functions and structure,2 eg, postural control and some gait parameters and activity/participation2 (eg, self-selected walking speed). Recent systematic reviews of BWSTT in children describe weak evidence with no randomized clinical trials.3,4,5,6 However, the evidence for BWSTT varies by diagnosis, with the strongest evidence suggesting positive outcomes in children with Down syndrome7,8,9 and limited evidence for children with cerebral palsy5,10,11,12 and spinal cord injury.14,15 Studies also describe the use of BWSTT for children with myelomeningocele16 and adults with Guillain-Barre,17 stroke,18 and traumatic brain injury.19 No adverse side effects have been reported with the use of BWSTT in children.

Best Practice
The decision to incorporate BWSTT into a plan of care for a child should be made in collaboration with the child, family, and members of the rehabilitation team. Most studies describe a period of BWSTT followed by locomotor training over ground within a single treatment session. Valid and reliable measures of activity and participation should be used to evaluate outcomes with BWSTT. Possible resources for measurement of outcomes include:

- Measurement of spatiotemporal gait parameters using pedographs, eg, paper or electronic walkways13,20,21
- Gait speed using timed walk tests, eg, 10-Meter-Walk Test, 6-Minute-Walk Test22
- Gross Motor Function Classification System (GMFCS) Sections E & R23
- Gross Motor Function Measure Section 66 (Dimensions D & E)24,25
- Functional Independence Measure for Children II (WeeFIM II)26
- Canadian Occupational Performance Measure (COPM)27
- Timed Up and Go Test (TUG)28
- Goal Attainment Scaling (GAS)29
- Standardized Walking Obstacle Course (SWOC)30
- Pediatric Evaluation of Disability Inventory (PEDI)31

BWSTT has been used as a physical therapy intervention in multiple settings, including schools, outpatient clinics, and inpatient rehabilitation settings.10,15,32,33 Although specific equipment is needed, studies report the use of BWSTT as a home program intervention completed by parents with the support of physical therapy.9,33 Specific protocols for use of BWSTT are currently unavailable, however, frequently reported parameters suggest guidelines (Table).

Table. Guideline for Use of Body-Weight–Supported Treadmill Training

<table>
<thead>
<tr>
<th>Frequency</th>
<th>2-5 days per week</th>
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<tbody>
<tr>
<td>Session length</td>
<td>5-30 minutes per session (does not include setup or getting on/off equipment)</td>
</tr>
<tr>
<td>Treadmill speed</td>
<td>.05 mph-3 mph</td>
</tr>
<tr>
<td>Percent body-weight support</td>
<td>Load stance limb</td>
</tr>
</tbody>
</table>
Use least amount of body weight support to maintain erect postural alignment

Manual assistance
Least amount required for stepping
Assist intra- and inter-limb coordination

Support using arms/hands
Fading use of handrails

Episode of treatment
2-16 weeks

**Equipment**

A variety of BWSTT equipment has been described, including custom-made portable treadmills (Carlin’s Creations, www.carlinscreations.com/), LiteGait WalkAble over a GaitKeeper treadmill (Mobility Research, www.litegait.com), and the Lokomat, a robotically driven (motorized) gait orthosis (Hocoma, www.hocoma.ch/en/). Equipment costs and staff resources needed to implement this intervention vary significantly. Manually assisted BWSTT may require the assistance of 2-4 trained people to facilitate movement of the child’s legs while supported in an upright position. Robotic-assisted BWSTT may offer a safer alternative, reducing the risk of injury to therapists if the child needs manual assistance with step control. This is especially true when BWSTT devices are used with larger children or children with more motor involvement.

**Limitations**

This document is not intended to provide comprehensive guidelines for physical therapists on the use of BWSTT. Physical therapists are encouraged to obtain and review current peer-reviewed literature in order to make informed clinical decisions prior to including this or any procedural intervention into a patient plan of care. The following Web sites are recommended to access these articles:

- PubMed (www.pubmed.gov): The National Institute of Health’s database for medical literature. A bibliographic database of journals covering alternative and complementary therapies is accessible through PubMed. If studies found in searches were supported by federal dollars, the full research papers are now available at no cost.
- Cochrane Reviews (http://www.cochrane.org/reviews/): Consensus documents, meta-analyses, and systematic reviews on topics, if available.
- Physiotherapy Evidence Database (PEDro) (www.pedro.org.au): The evidence-based review of topics by The George Institute of International Health and the University of Sydney.

Remember that even published research papers should be evaluated to determine the level of evidence and the extent to which the results can be generalized to practice. For assistance with evaluating research evidence, see The Guidelines for Critical Review Form, Quantitative Studies (http://www.canchild.ca/en/can-childresources/resources/quantguide.pdf).

**Future Work**

Additional research is needed to demonstrate the efficacy of BWSTT. The type of assistance provided to the child on the treadmill (robotic versus manual) also requires further investigation. Finally, more rigorous studies are needed to determine the effectiveness of BWSTT in different populations and the recommended parameters, eg, treadmill speeds, amount of body-weight support, session length and frequency, optimal episode of treatment including BWSTT.
References


**Web Sites for Photos Listed in Figures 1-3:**

Figure 1: [http://www.kines.umich.edu](http://www.kines.umich.edu)

Figure 2: [http://litegait.com](http://litegait.com)

Figure 3: [https://hocoma.com](https://hocoma.com)

**For More Information**


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