

# Body Weight Supported Treadmill Training

Authors: SCIRE Community Team | Reviewers: [Tania Lam](#) and [Shannon Sproule](#) | Published: 29 Nov 2017

Body weight supported treadmill training is a therapy that can be used to support walking training after spinal cord injury (SCI). This page outlines basic information about the use of body weight supported treadmill training after SCI.

## Key points

- Body weight supported treadmill training is a therapy modality in which part of a person's body weight is supported while walking on a treadmill.
- It is usually used to work on walking ability, walking speed, and fitness in people with some control of movement in their legs after SCI (usually people with incomplete SCI).
- Research evidence supports that body weight supported treadmill training is effective to help improve walking in people with incomplete SCI. It may also have benefits for fitness, reducing spasticity, and overall wellness.
- The relationship between body weight supported treadmill training and stepping movements after complete SCI is not well understood. Further research is needed to understand whether body weight supported treadmill training has potential treatment benefits on walking (*locomotor*) function for people with complete injuries.

## What is body weight supported treadmill training?

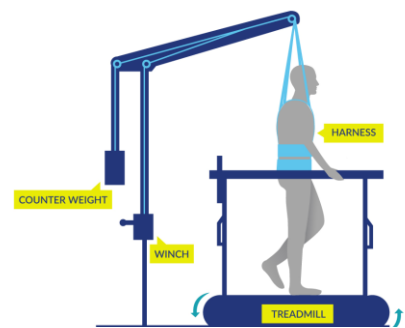
Body weight supported treadmill training is a therapy modality in which part of a person's body weight is supported while walking on a treadmill. It is usually done using an overhead suspension system attached to a harness that supports part of a person's body weight over a treadmill. While supported, the person walks with or without assistance from health providers on a treadmill.

Body weight supported treadmill training is usually used to work on walking in people with some control of movement in their legs after SCI (usually people with incomplete SCI).

The goals of treatment with body weight supported treadmill training may include:

To practice walking and standing

Body weight supported treadmill training is usually used to work on walking and standing skills after incomplete SCI. Because the body weight is partially supported, walking can be practiced even when a person cannot stand or walk independently. This may also allow for walking training to begin earlier after injury.



Body weight supported treadmill training is usually done using an overhead suspension system and harness that supports the body over a treadmill<sup>1</sup>

### To work on walking quality and speed

Body weight supported treadmill training may be used to practice better walking patterns and prevent unwanted movement compensations that can happen during unsupported walking. It may also allow a person to safely practice walking at faster speeds. This may provide important feedback to the nervous system to help with learning.

### To train fitness and health

Standing upright and walking may have benefits for cardiovascular fitness and overall health. It may also have other benefits, such as improving spasticity and feelings of wellness.

## How is body weight supported treadmill training done?

Body weight supported treadmill training usually involves the use of an overhead harness and suspension system that supports the person in standing over a treadmill. There are other forms of body weight support training, such as underwater treadmills, anti-gravity treadmills and robotic assisted systems, although these are less common in standard clinical settings.

The amount of body weight that is supported will be different for each person depending on the characteristics of their SCI (such as the level of injury), the level of support provided by the health providers, and the person's experience with the training.

### Equipment

Body weight supported treadmill training may involve the use of several different pieces of equipment, depending on the type of support provided. The most common type of harness and suspension system may involve a variety of pieces of equipment such as:

- A harness
- Groin and abdominal straps and padding
- An overhead suspension system
- A treadmill with adjustable speeds
- A ramp up to the treadmill
- Additional tubing or strapping
- Parallel bars
- Braces and orthoses



*Equipment for a suspension type system includes a treadmill, overhead suspension system, and harness<sup>2</sup>*

Some body weight supported treadmill training systems may also involve the use of computer systems which control the training and/or robotic systems which guide movement of the legs.

### Procedures

The exact procedures depend on the type of equipment used and the person's physical abilities. General procedures for use of a standard harness and overhead suspension system may include the following steps:

- In order to ensure this treatment is safe for you, your health providers will measure your heart rate, blood pressure, and assess your risk of fractures before beginning this treatment.
- Your health providers will help you put the harness and groin straps on in a lying or standing position. The harness



*Female clinician adjusting the harness, preparing a man for the treadmill.<sup>3</sup>*

is then tightened so it does not slide up when weight is supported.

- The harness is then securely connected to the overhead suspension over the treadmill and you are lifted up using a mechanical lift to support some weight. There are usually bars on the side to hold on to for balance.
- Once you are standing upright, your health provider will then turn on the treadmill and gradually increase the speed of the treadmill. Depending on your needs and abilities, hands-on assistance or braces may be used to help move the legs or control the trunk and pelvis.



Training usually begins with maximum body weight support at a slow speed. The amount of support is usually between 35% and 50% of body weight, but depends on your ability to stand on one leg without it buckling. As you get used to the training, the amount of support provided is reduced and the speed or time spent on the treadmill can be increased. It is important to maintain a good quality walking pattern to practice normal movement patterns.

### Amount of training

Your health provider will determine how long the training will last, depending on you and your training goals, as well as the availability of equipment and staff. Body weight supported treadmill training is often done for 15 to 30 minutes two to five times per week. However, we do not know what the optimal amount of training is.

### Additional therapies

Body weight supported treadmill training is just one of many different walking therapies for people with SCI. It is often accompanied by other forms of walking training such as:

- Walking over ground (off the treadmill) with or without an assistive device, such as a walker. This may be used to help reinforce walking after treadmill training in a form that is more realistic to everyday movement.
- Functional electrical stimulation (FES) can be applied to the muscles of the legs and trunk during treadmill training to stimulate muscle activity. This may help to create stronger muscle contractions in weakened muscles when walking. Special FES systems (such as foot control systems that raise the toes up with each step) may be used to help with coordination when stepping.



It is important to speak with a health provider about body weight supported treadmill training to make sure it is safe and suitable for you and to learn how to use the equipment correctly.

## Are there restrictions or precautions for body weight supported treadmill training?

There are some situations in which body weight supported treadmill training may be unsafe to use. This not a complete list, speak to a health provider about whether this treatment is safe and appropriate for you.

Body weight supported treadmill training should not be used in the following situations:

- By people with medical conditions where heart rate, blood pressure, or seizures are uncontrolled
- By individuals who are unable to stay upright for 5-10 minutes without a major drop in blood pressure
- By people at risk of broken bones (fractures), such as people with severe osteoporosis or recent fractures
- By people with joint limitations (such as contractures) which limit walking, weight-bearing, or standing
- In areas where the harness may put pressure on open wounds or areas at risk of pressure sores
- By people using mechanical ventilation

Body weight supported treadmill training should be used with caution in the following situations:

- When there are tubes or lines attached to the body, such as a feeding tube or indwelling catheter
- By people with severe and uncontrolled spasticity
- By people with blood clots or a history of blood clots
- By people with other major medical conditions or injuries
- By people prone to autonomic dysreflexia

## What are the risks and side effects of body weight supported treadmill training?

There are some risks and side effects that should be discussed before participating in body weight supported treadmill training. This is not a complete list; ask your health providers for more detail.

Risks and side effects of body weight supported treadmill training may include:

- Groin discomfort or pain around the harness
- Skin irritation near where skin or clothes are shearing against the harness
- Abdominal discomfort or difficulty breathing if the harness is too tight
- Broken bones (fractures)
- Muscle strain, soreness, or injuries
- Worsening of muscle spasms
- Autonomic dysreflexia
- Changes in blood pressure that may cause light-headedness and dizziness

## Are there other limitations to using this treatment?

In addition to the risks and side effects of body weight supported treadmill training, there are also practical limitations its use, including:

- It is challenging to use and sometimes requires assistance from up to four people
- The equipment and staff time needed for body weight supported treadmill training can be very costly
- Many facilities do not have the staff or equipment to use body weight supported treadmill training in their day to day programs

## Does body weight supported treadmill training improve walking after incomplete SCI?

### Walking

Research studies have found that body weight supported treadmill training may help to:

- Improve walking ability in people with chronic incomplete SCI (weak evidence)
- Improve walking to a similar degree as walking off the treadmill at a similar intensity in people with recent incomplete SCI (moderate evidence)
- Improve functional walking in people with incomplete SCI when used together with functional electrical stimulation (FES) of the leg muscles (moderate evidence)



However, the benefits for walking do not appear to be unique to this type of training. Most walking strategies which involve weight-bearing (including walking overground, treadmill walking, and walking with FES) appear to be equally effective at improving walking after incomplete SCI.

### Cardiovascular fitness

Several studies have looked at the effects of body weight supported treadmill training on different aspects of cardiovascular fitness after SCI. Taken altogether, these studies provide early evidence that body weight supported treadmill training helps to improve many aspects of cardiovascular fitness and health in people with complete and incomplete tetraplegia and paraplegia.

### Other effects

In addition to benefits for walking and fitness, body weight supported treadmill training may also have other effects after SCI.

- Body weight supported treadmill training may help to improve spasticity (weak evidence)
- Body weight supported treadmill training may lead to greater life satisfaction and well-being (weak evidence)
- Body weight supported treadmill training has been thought to improve bone density after SCI, however, early research suggests that it may not help to prevent bone loss after SCI (weak evidence).

## Can body weight supported treadmill training cause stepping after complete SCI?

Although we tend to think about walking as being entirely voluntary, the ability to step and walk is actually related to both conscious and unconscious (automatic) processes. Some of the automatic walking processes are thought to be controlled within the spinal cord by networks of nerve cells known as central pattern generators or CPGs.

## What are central pattern generators (CPGs)?

Central pattern generators (CPGs or spinal pattern generators) are networks of nerve cells in the spinal cord that generate rhythmic movement patterns. These networks do not require signals from the brain or sensation to keep going once they are activated.

CPGs were discovered when researchers found that animals with complete SCI demonstrated stepping movements when they were supported over a treadmill. These animals could not start the movement themselves, but once it was triggered (typically by electrical stimulation, application of certain drugs, or sensory stimulation to an area between the pubic bone and sacrum called the perineum), the stepping movements continued in a rhythmic pattern which resembled walking.

These networks of nerve connections are thought to be located within the spinal cord itself and exist to allow repetitive movements to continue without the need to think about each step.

## Evidence for central pattern generators in humans with complete SCI

Researchers are still unsure about whether central pattern generators can be activated after complete SCI in humans. Researchers have suggested several observations that may show evidence of central pattern generators after complete SCI in humans, including:

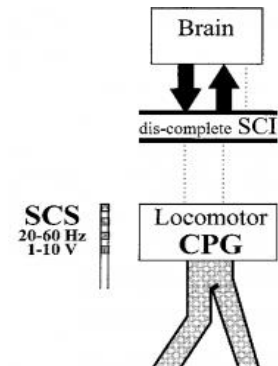
- Spontaneous rhythmic movements below the level of injury;
- Stepping-like movements when electrical stimulation is applied through an electrode implanted over the spinal cord (epidural stimulation); and
- Rhythmic muscle contractions that can be induced through treatment with certain drugs.

However, there is debate among researchers about whether these findings really show evidence of central pattern generators or not. It is also not clear if central pattern generators are activated during body weight supported treadmill training after SCI.

## Automatic stepping is not walking

It is also important to consider that automatic stepping is **not** walking. Walking is much more complex, involving many other components, such as strength to support the body weight, balance to stay upright and shift weight, and sensation and voluntary control to adapt to the environment and situation. For these reasons, even if central pattern generators are activated after complete SCI, we do not know whether this will help a person regain walking ability or have any other benefits for functional walking.

Further research is needed to better understand central pattern generators after complete SCI. At this time, body weight supported treadmill training continues to be used clinically as a treatment for people with incomplete SCI who retain some movement in the legs.



*Generation of rhythmic movement through the CPG is debatable in people with SCI*

## The bottom line

Overall, the research evidence suggests that body weight supported treadmill training has positive effects on walking after incomplete SCI that are similar to other forms of walking training. It may also have benefits for fitness, spasticity, and wellness after SCI, although more high quality research is needed to confirm.

Body weight supported treadmill training appears to be relatively safe when used appropriately, however the equipment and support needed for this treatment may not be commonly available for regular use. If you are interested in this treatment, discuss your options with your health providers to find out if it is suitable to you.

For a list of included studies, please see the [Reference List](#).

## Abbreviated reference list

Parts of this page have been adapted from the SCIRE Project (Professional) “Lower Limb”, “Cardiovascular Health and Exercise”, “Bone Health”, “Depression after SCI” and “Spasticity”. chapters:

**Lam T, Wolfe DL, Domingo A, Eng JJ, Sproule S (2014). Lower Limb Rehabilitation Following Spinal Cord Injury.** In: Eng JJ, Teasell RW, Miller WC, Wolfe DL, Townson AF, Hsieh JTC, Connolly SJ, Noonan VK, Loh E, McIntyre A, editors. *Spinal Cord Injury Rehabilitation Evidence*. Version 5.0. Vancouver: p 1-74.

Available from: <http://scireproject.com/evidence/rehabilitation-evidence/lower-limb/>

**Warburton DER, Krassioukov A, Sproule S, Eng JJ (2014). Cardiovascular Health and Exercise Following Spinal Cord Injury.** In Eng JJ, Teasell RW, Miller WC, Wolfe DL, Townson AF, Hsieh JTC, Connolly SJ, Noonan VK, Loh E, McIntyre A, editors. *Spinal Cord Injury Rehabilitation Evidence*. Version 5.0. Vancouver: p 1-48.

Available from: <http://scireproject.com/evidence/rehabilitation-evidence/cardiovascular-health-and-exercise/>

**Craven C, Lynch CL, Eng JJ (2014). Bone Health Following Spinal Cord Injury,** In Eng JJ, Teasell RW, Miller WC, Wolfe DL, Townson AF, Hsieh JTC, Connolly SJ, Noonan VK, Loh E, McIntyre A, editors. *Spinal Cord Injury Rehabilitation Evidence*. Version 5.0. Vancouver: p 1-37.

Available from: <http://scireproject.com/evidence/rehabilitation-evidence/bone-health/>

**Orenczuk S, Mehta S, Slivinski J, Teasell RW (2014). Depression Following Spinal Cord Injury.** In Eng JJ, Teasell RW, Miller WC, Wolfe DL, Townson AF, Hsieh JTC, Connolly SJ, Noonan VK, Loh E, McIntyre A, editors. *Spinal Cord Injury Rehabilitation Evidence*. Version 5.0. Vancouver: p 1-35.

Available from: <https://scireproject.com/evidence/rehabilitation-evidence/depression-following-spinal-cord-injury/>

**Hsieh JTC, Connolly SJ, McIntyre A, Townson AF, Short C, Mills P, Vu V, Benton B, Wolfe DL (2016). Spasticity Following Spinal Cord Injury.** In Eng JJ, Teasell RW, Miller WC, Wolfe DL, Townson AF, Hsieh JTC, Connolly SJ, Curt A, Mehta S, Sakakibara BM, editors. *Spinal Cord Injury Rehabilitation Evidence*. Version 6.0.

Available from: <https://scireproject.com/evidence/rehabilitation-evidence/spasticity/>

Full reference list available from: <https://community.scireproject.com/topic/body-weight-supported-treadmill/#reference-list>

Glossary terms available from: <https://community.scireproject.com/topics/glossary/>

### Image credits

1. Image by SCIRE Community Team
2. 'Figure 1. Device for body weight support (LINAK, Silkeborg, Denmark) and treadmill (FITEX T-5050; Fitex, Gwangju, Korea) and treadmill' from: Joon Lee B, Lee HJ, Lee, WH. The effects of intensive gait training with body weight support treadmill training on gait and balance in stroke disability patients: a randomized controlled trial. *Phys Ther Rehabil Sci.* 2013;2(2),104-110.
3. Image by SCIRE Community Team
4. Image by SCIRE Community Team
5. Image by SCIRE Community Team
6. Image by SCIRE Community Team
7. 'Figure 3 `Central' tonic input, external train of electrical stimulation, delivered by SCS can induce stepping movements' from: Pinter, M. M., & Dimitrijevic, M. R. (1999). Gait after spinal cord injury and the central pattern generator for locomotion. *Spinal cord*, 37(8), 531.

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