

Spinal cord injury and exercise

What is spinal cord injury?

The spinal cord is the major conduit through which the brain sends motor commands and receives sensory information. Spinal cord injury (SCI) refers to damage resulting from trauma (e.g. motor vehicle accidents or falls). In Australia, approximately one person sustains a spinal cord injury each day, with incidence being highest (30%) in the 15-24 years age group. Males are 5.3 times more likely to be injured than females. Transport related injuries (46%) and falls (28%) account for 74% of SCI in Australia and approximately 10,000 Australians live with an SCI.

SCI usually results in impairments of motor and sensory function, as well as autonomic function (e.g. sweating and heart rate control). Two factors determine which of these functions are impaired and how much they are impaired:

- **The level of the injury.** The higher the injury occurs, the more function is impaired. Tetraplegia (preferred to quadriplegia) refers to injuries in the neck region and typically results in impairments of arm, trunk and leg function. Paraplegia refers to injury below the neck and while trunk and leg function is impaired, arm function is preserved;
- **The completeness of the injury.** When an injury does not damage the full thickness of the spinal cord, some connections with the brain remain intact and some function can be preserved. The amount of function preserved is highly variable, even for people with injuries at the same level. The function retained may be minor (e.g., small patches of sensation) or major (e.g., the ability to walk without aids). In Australia incomplete injuries (65%) are more common than complete (35%).

Variability in the level and completeness of SCI means that functional outcomes can vary from people who use a motorised wheelchair, require mechanical assistance to breath and personal assistance to leave their wheelchair, to those who can walk independently and drive a car with minimal assistance.

How does exercise help?

The evidence presented below relates to people with SCI who have been discharged from hospital and who undertake types of exercise similar to the general population. Evidence relating to in-patient rehabilitation exercise and specialised electromechanical modes of exercise such as Functional Electrical Stimulation is not presented.

People with mobility impairments, including people with SCI, are among the most physically inactive members of society. This profound physical inactivity is very harmful for health, fitness and function, and compounds the consequences of SCI. Furthermore, the acute response to exercise is often restricted in people with SCI. This is because the muscles most frequently paralysed are the large, lower-limb muscles, meaning that only the smaller muscles of the arms and shoulders can be used to stimulate the heart and lungs and burn up calories. People with tetraplegia may also have a reduced exercising heart rate due to impaired autonomic innervation of the heart. Nonetheless, research shows that:

- Aerobic exercise (e.g. wheelchair pushing, hand cycling, swimming) improves cardiorespiratory fitness, reduces the risk of cardiovascular disease. It may also reduce the incidence of urinary tract infections, a common problem in people with SCI;
- Resistance training improves strength of non-paralysed muscles in people with SCI and may improve strength of partially-paralysed muscles;
- Exercise interventions can enhance functional independence (e.g., the ability to transfer into and out of a wheelchair or push independently in the community);
- Physical activity is associated with greater life satisfaction and people who exercise can decrease depression and anxiety, and increase quality of life;
- Exercise may be associated with greater health of the bones in paralysed limbs.



What exercise is best for people with SCI?

Because the function of people with SCI is extremely varied, and the quantity and quality of research is limited, specific, prescriptive recommendations for exercise programs are not possible. However some general recommendations can be made:

- Health professionals should strongly encourage people with SCI to be as physically active as they can be;
- To improve aerobic fitness and strength, the minimum frequency, intensity and duration of exercise is 20 minutes of moderate to vigorous intensity aerobic (cardio) activity two times per week AND strength training exercises two times per week (three sets of 8-10 repetitions of each exercise for the major muscle groups);
- Exercise guidelines for good health for people with SCI are the same as those for the general population: at least 150 minutes of moderate-intensity aerobic activity on most or all days of the week;
- Strength training for non-paralysed muscle should follow guidelines for the general population. To increase strength in partially-paralysed muscles, commence with unresisted, gravity eliminated movements, progress to gravity opposed movements and finally to gravity opposed movements with resistance;
- Flexibility training is a recommended component of a comprehensive exercise training program. Exercising out of the wheelchair should be encouraged where possible;
- Avoid exercising in hot weather. Dress in cool, light clothing, seek shade, use spray bottles.

Note that upper extremity pain is a common comorbidity in manual wheelchair users, resulting from long-term overuse and transfers in and out of the wheelchair. However, this does not mean exercise should be avoided by this population - evidence indicates that, compared with athletes, non-athletes are twice as likely to be affected by shoulder pain. Furthermore, exercise interventions that avoid painful movements and include targeted strengthening exercises can reduce upper extremity pain;

When healthy but previously inactive adults with SCI initially commence exercise, note that:

- Priority should be given to establishing a regular, weekly exercise routine;
- Exercise intensity and duration should be low and increase gradually, particularly in those with tetraplegia or a history of low blood pressure. Short Interval training (e.g., 5 min work: 5min recovery) at low intensity may assist the very unfit to accumulate sufficient aerobic duration;
- Changing position (e.g. from lying to sitting) should be done slowly and carefully, especially if help is needed to change position; and
- People with reduced sensation should be cautious with new activities, check for red areas after exercising and, where possible, sit on their own cushion when using exercise equipment.

References and further information

Exercise is Medicine Australia www.exerciseismedicine.org.au

Find an Accredited Exercise Physiologist www.essa.org.au

Exercise Right www.exerciseright.com.au

Spinal Cord Injury Network www.spinalnetwork.org.au

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