

HEALTH, WELLNESS, FITNESS AND THE REHABILITATION CONTINUUM

INTRODUCTION

Achieving health, wellness and fitness for the SCI/D population is an important goal to improve quality of life and counter the effects of a sedentary lifestyle post injury. Inactivity increases the risk for preventable cardiopulmonary and metabolic diseases, contributes to multi-system medical complications, activity limitations and accelerated aging.^{1,2,3,4}

Addressing current barriers and providing structured guidance may motivate wheelchair users to improve attitudes toward physical exercise and encourage them to engage in regular exercise whether it be at home, public gyms or within the community.

This chapter aims to help educate individuals, families, health care providers, and third party payers in regards to exercise benefits, current guidelines and exercise prescriptions, aspects of a structured fitness program, and provide information on adaptive equipment, sports and recreation for people with spinal cord injury.

BENEFITS OF EARLY MOBILIZATION AND EXERCISE

Acute

In the acute setting, educating patients on the risks of prolonged bed rest is important to understand the benefits of early mobilization after SCI. The complications of acute immobility for the general population include rapid loss of muscle mass,⁵ cognitive and psychological issues, difficulties with mechanical ventilation weaning and increased length of stay. Muscle weakness after intubation and bedrest occurs first to the respiratory muscles and then to the peripheral muscles which can contribute to prolonged disability.⁶ Muscle weakness of the diaphragm, intensive care unit-acquired weakness, critical illness polyneuropathy and critical illness myopathy are all associated with mechanical ventilation and immobility in the ICU. These conditions correlate with prolonged mechanical ventilation and ICU length of stay, increased costs of hospitalization and increased long

term morbidity and mortality.⁷ In addition, prolonged bed rest results in increased fluid losses which can contribute to decreased stroke volume, cardiac output, and peak oxygen uptake.⁸ Other adverse events reported include ventilator acquired pneumonia, hospital-acquired pneumonia and the development of pressure ulcers.¹⁰ The pulmonary risks for those with acute spinal cord injury are exacerbated by spinal shock and its deleterious effects on pulmonary function including worsening ventilation, increased work of breathing, atelectasis, and poor secretion management.

The benefits of early mobilization include improved ventilation, functional capacity, perfusion, muscle strength and reduction in hospital acquired infections.^{9,10} It has also been associated with decreased duration of mechanical ventilation and delirium, improved functional outcomes at hospital discharge, contributed to shorter duration of both ICU and hospital stays, and decreased one-year mortality rates.^{10,11,13,14}

In a retrospective chart review, Ronnenbaum et al reported that implementation of a mobility protocol resulted in an average of 11.6 days fewer days in the ICU and a \$22,000 savings per patient.¹⁵

Chronic

The health benefits of implemented regular exercise are multifaceted, influencing physical well-being and overall psychosocial function.^{16,17,18} There is consistent evidence that a regular fitness program for individuals with SCI has the following positive effects:

- Cardiac/ Respiratory
 - Decreased levels of inflammatory markers (IL-6 and CRP) resulting in reduced risk of CVD rates (paraplegia>tetraplegia)¹⁹



- Improved overall functional capacity including VO₂peak and power output²⁰
- Improved cardiac autonomic balance²¹
- Decreased platelet aggregation and blood coagulation²²
- Improved lipid lipoprotein profiles²³
- Decreased LDL and Total cholesterol²⁴
- Decreased vascular resistance and increased muscle blood flow both at rest and with aerobic activity²⁵
- Increased peak exercise tolerance²⁶
- Increased peak oxidative metabolic cellular changes²⁷
- Improved vital capacity and increase in maximum volume of expired air when exercising²⁸
- Increased FVC, FEV₁, and PEF²⁹
- Improved FVC, FEV₁, FEV₁/FVC, and FEF³⁰
- GU
 - Increased bladder capacity, voiding efficiency and detrusor contraction time³¹
 - Decrease in voiding pressure³¹
 - Decrease in frequency of nocturia and urinary incontinence³¹
- GI/ Metabolic
 - Decreased total serum cholesterol, body fat and BMI
 - Reduced harmful low density lipoprotein cholesterol, and increased high-density lipoprotein cholesterol
 - Improved glucose homeostasis and insulin sensitivity
 - Increased fasting insulin concentrations and reduced insulin resistance
 - Improved hepatic insulin sensitivity²⁰
 - Improved glucose homeostasis preventing or reversing Type 2 Diabetes Mellitus³²
- Skin
 - Maintained skin integrity and prevented pressure ulcers, which results in savings between \$124,000-\$129,000³³
- Bone
 - Improved bone mineral density reducing incidence of osteoporosis in SCI⁷⁰
- Neuro/MSK/Spasticity
 - Improved sitting posture, wheelchair propulsion which leads to improved mobility and functional independence
 - Improved balance and gait
 - Decreased shoulder pain from shoulder instability related to muscle weakness³⁵
- Psychosocial
 - Improved overall quality of life through reduction of stress, pain, anxiety, and depression as well as enhanced self confidence, self-image, and energy leading to better community reintegration – needs superscript citation^{4,36,37}

MEDICAL CONSEQUENCES OF SCI

It is important that persons with spinal cord injury be aware of the physical changes, complications and injuries that could affect their fitness program. The level and type of spinal cord lesion determines the extent of the physiological changes that occur though muscle weakness is consistent across all individuals with SCI/D.^{1,38} While an in-depth explanation of the medical consequences of spinal cord injury is beyond the scope of this chapter, we will highlight the most significant changes that should be considered when designing, instituting, or performing any exercise program. We recommend that individuals with SCI/D should speak to their physicians for more information.

Autonomic dysreflexia (AD) is a dangerous, and potentially lethal clinical syndrome which may occur for individuals with SCI/D above T6 resulting in acute, uncontrolled elevation in blood pressure. It can be triggered by ill-fitting equipment or machines that utilize electrical stimulation causing a painful stimulus. Persons with SCI/D should watch for signs of AD during exercise and stop the activity if symptoms develop. Equipment that is ill-fitting can also lead to pressure induced skin injuries therefore close monitoring of skin and pressure areas after use is also essential along with frequent pressure breaks every 20-30 minutes during exercise.



Individuals with SCI/D are at higher risk for osteoporosis and bone fractures after injury. Due to this, any standing exercises or activities should first be cleared by their physician. A dual-energy x-ray absorptiometry (DEXA) scan may be indicated in order to stratify fracture risk.

Heart rate may also be affected in individuals with SCI/D especially with cervical or high thoracic injuries. They may experience an inadequate rise in heart rate (may plateau at 120 BPM) and oxygen intake during exercise. Rather than using heart rate to measure exercise intensity, other measures such as the Borg Rating of Perceived Exertion Scale or the Modified Borg Dyspnea Scale may be more indicative of the exercise intensity for an individual with SCI/D than heart rate alone.

Finally, when exercising, persons with SCI/D should be aware of the potential for thermal dysregulation. Especially for those with dysfunction of the spinal cord T8 and above, they may not be able to adequately sweat or cool off appropriately during exercise. Persons with SCI/D should ensure adequate room temperature and fluid intake to support vigorous exercise.

OTHER BARRIERS TO PHYSICAL ACTIVITY FOR SCI

Psychological barriers also exist for individuals with SCI including lack of motivation, reduced energy, depression, lack of self confidence, fear and concern about physical limitations which make participating

in a fitness program difficult.³⁹ Many of these psychosocial challenges are further exacerbated by lack of accessible gyms with wheelchair equipment, lack of SCI experienced trainers at fitness centers, financial barriers, lack of transportation to gyms and exercise facilities, and general lack of awareness of exercise and adaptive sports programs.^{40,41,42,43} It is important that individuals with SCI/D are encouraged and provided the opportunity to get involved in the fitness community including sports and recreation. Education on the benefits of exercise and providing exercise guidelines for this population should start from the point of rehabilitation and continued throughout their lifetime. Providing available information on adaptive equipment and adaptive sports will be beneficial in countering some of these perceived limitations and barriers.

EXERCISE COMPONENTS AND PRESCRIPTION

Although exercise programs are highly variable, the core components should be consistent. The FITT protocol was developed to ensure completeness when prescribing or incorporating an exercise program. The FITT protocol is composed of Frequency, Intensity, Time and Physical Activity Type. Frequency, intensity and time are variable and are discussed in further detail in Exercise Guidelines. Physical activity types include aerobic exercise, resistance training, and flexibility.

Individuals with spinal cord injury are at a heightened risk of cardiovascular disease, therefore cardiovascular training is essential. However, an aerobic program should be tailored to the individual's specific capabilities and should consider the previously mentioned risks that individuals with SCI/D face. Aerobic exercise may include activities such as arm-crank ergometry, swimming, and adaptive exercises. In addition, if appropriate, people with SCI/D may benefit from a locomotor training program that includes body weight supported treadmill training with either hands-on facilitation or robotics. Standers/standing frames can additionally provide weight bearing for individuals with SCI/D. Benefits include countering osteoporosis, improving bowel/ bladder, improving spasticity, promoting and maintaining range of motion throughout the lower extremities, preventing contractures and improving psychological

well-being. Many of these standing frames can be utilized to perform upper extremity exercises and some have gliding functions for both upper and lower extremity training.

A comprehensive exercise program should also include resistance training and muscle strengthening. Upper extremity (UE) strengthening should focus on elbow extension, shoulder flexion and horizontal adduction, scapular protraction and depression, and trunk musculature as these muscles play an integral role in performing most functional activities in complete injuries. All UE exercise programs should take into account the increased incidence of shoulder pain and injury following SCI/D and work on balancing musculature as well as scapular and shoulder stabilization. Strengthening the lower extremities may improve ambulation outcomes, promote ease of transfers, and can address motor control and endurance impairments. Abdominal and trunk/core muscle strengthening may also ease transfers, improve sitting balance, and improve stability for ambulation.

Strengthening and resistance training can be achieved without equipment using proprioceptive neuromuscular facilitation (PNF), isometric, eccentric, concentric, and isokinetic strengthening exercises. Dumbbells, wrist and ankle cuff weights, weighted dowels, therabands, weighted balls, sled machines, press machines, and/or tubing can be used in resistance programs. In addition, there are multi-station resistive exercise machines as well as some cardiovascular equipment that can confer strengthening benefits. Counterbalance arm slings and arm skates can help assist with strengthening and neuromuscular reeducation if a patient has motion in an indicated muscle but not enough strength to perform against gravity or resistance.^{44,45}

Flexibility exercises are also important in the setting of spasticity and muscle imbalance and can help prevent contracture, maintain joint range of motion, and protect from overuse injuries. Flexibility exercises may include activities like adaptive yoga or passive and active stretching. Stretching can also protect the ability to use a tenodesis grip in individuals without active wrist and finger extension. Individuals who may have a difficult time carrying out a stretching program on their own due to their level of injury, can enlist the help of a therapist, aide, family member or friend.

In addition to the cardiovascular, strengthening, and flexibility exercises outlined above, individuals with SCI/D may also have weakened respiratory musculature and cough strength. Respiratory muscle training for both inspiratory and expiratory muscles has been shown to improve respiratory muscle strength and lung volumes.^{46,47,48} Therefore, breathing exercises should be incorporated into a patient’s program as early as they are able to improve respiratory function. Some exercises can be done without equipment such as deep breathing, triple breath holds, number counting, quick breaths, and coughing. There are also small handheld devices which can be used for respiratory muscle training at home with or without assistance.

EXERCISE GUIDELINES FOR SCI

The American College of Sports Medicine⁴⁹, The World Health Organization⁵⁰, and the US Physical Activity Guidelines Advisory Committee⁵¹ have all provided systematically developed, evidence based guidelines regarding activity requirements to maintain physical health and reduce morbidity and mortality for the general population (**Table 1**). However, these guidelines were not tailored specifically for individuals with SCI/D. Therefore, researchers are working to

Table 1: ACSM Physical Activity Recommendations

| American College of Sports Medicine Physical Activity Recommendations | | | |
|---|---------------------------------------|-------------------|----------------------|
| | Cardiovascular (Aerobic) Training | Strength Training | Flexibility Training |
| Frequency | ≥ 5 days per week ≥3 days per week | ≥ 2 days per week | N/A |
| Intensity | Moderate Vigorous | | |
| Duration | ≥ 30 minutes ≥ 20 minutes | | |

Table 2: Dr. Martin Ginis et al Exercise Recommendations

| | Cardiovascular Health* | Muscle Strength and Endurance* | Flexibility and Range of Motion |
|-------------------|--|---|---|
| Frequency | Minimum 2 days/week | Minimum 2 days/week | Daily |
| Intensity | Moderate to vigorous [†] | 8–10 repetitions | 30–60 seconds/stretch; gentle , slow, pain free |
| Duration | 20–30 minutes/session | 3 sets; 1–2 minutes rest between sets (30–60 minutes total) | 2 sets; 5–15 minutes |
| Activities | Wheeling, arm cycle, sports, recumbent stepper, aquatics, cycling, circuit training, functional electrical stimulation | Free weights, elastic resistance bands, cable pulleys, weight machines, functional electrical stimulation | Standing in standing frame (if medically cleared); passive and active static stretching |

* These cardiovascular and muscular strength/endurance recommendations are adapted with permission from SCI Action Canada (www.sciactioncanada.ca/guidelines accessed August, 2014).

[†] *Moderate intensity:* somewhat hard but can be sustained for long periods without experiencing excessive fatigue; *Vigorous intensity:* very hard, close to maximum and cannot be sustained for long without experiencing excessive fatigue.

develop exercise guidelines specific for the SCI/D population^{4,16,52,53,54,55,59,72}. While the exact amount of exercise to provide the optimal reduction of health-related morbidity and mortality for individuals with SCI/D are not known, Ginis et al 2018 showed the minimum frequency, intensity and duration required to maintain or improve physical capacity and muscle strength for individuals with SCI compared to sedentary lifestyle (**Table 2**).

EXERCISE AND ADAPTIVE EQUIPMENT

There has been an incredible amount of innovation and advancement in the development of equipment to encourage participation in physical activity for individuals with SCI/D. Equipment ranges from simple to complex and can be used in various standing, sitting, or laying positions. In addition, some pieces of equipment have integrated functional electrical stimulation (FES) in order to increase the cardiovascular and muscle strengthening effect. Finally, newer robotics are now available for rehabilitation and exercise use.

The following are some examples of the types of equipment that SCI individuals can use to maintain fitness. Many of these pieces can be used not only for cardiovascular training but for resistance/ strength training as well. In addition, we have also included

equipment used for balance and gait training. While many of the gait trainers may be beyond the scope of DME, and may primarily be seen in inpatient rehabilitation centers, they are included here for completeness.

Alternative Exercise Equipment

- The Burn Machine: <https://theburnmachine.com>
- Core Stix: <https://corestix.com>
- Check out their exercise page for ideas on exercise programs!
- Prestige Total Access: Equalizer Exercise Machines: <https://www.cybexintl.com/products/prestige-total-access.aspx>
- The Equalizer Exercise Machine: <http://www.equalizerexercise.com>
- The Genesis Dual Cable Cross: <https://freemotionfitness.com/strength-machine/dual-cable-cross>
- HUR USA Accessible Training Equipment: <https://hurusa.com/product-category/purpose/accessible-training>
- Wheelchair Fitness Solution: <https://www.wheelchairfitnesssolution.com>

UPPER EXTREMITY EQUIPMENT



Matrix Fitness Krankcycle



SCIFIT PRO1 Upper Body Exerciser

<https://www.scifit.com/product/pro1>



Concept2 SkiErg

<https://www.concept2.com/skierg/concept2-skierg>



Ropeflex Functional Trainer

<https://www.ropeflex.com>



Vitaglide

<https://www.vitaglide.com>

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Concept2 Rower

<https://www.concept2.com/>



Invictus Active Trainer

<https://www.invictusactive.com/product-category/trainers>



Hocoma ArmeoSenso

<https://www.hocoma.com/solutions/armeio-senso>



Hocoma ArmeoSpring

<https://www.hocoma.com/solutions/armeio-spring>

LOWER EXTREMITY EQUIPMENT

While the below pieces are primarily lower extremity cardiovascular/ strengthening exercise equipment, many have adaptations to also be upper body trainers. There are also options for supine vs. seated machines, and ones that can be used as a standing frame. Equipment that can be used in the supine position are great options for individuals who have not graduated to the inpatient rehabilitation phase and can be utilized for early mobilization treatments.



MOTomed loop.la

Copyright of RECK-Technik GmbH & Co. KG

Leg Arm/Upper Body Trainer

<https://www.motomed.com/en/products/motomed-loop-la/>



NuStep

<https://www.nustep.com>



GigerMD (supine)

<https://www.gigermd.com/en/>



MOTomed layson.la

(expandable chassis)

Copyright of RECK-Technik GmbH & Co. KG.

Supine Position - Bed

<https://www.motomed.com/en/products/motomed-layson-a>



Cybex Recumbent Bike

<https://www.cybexintl.com>



Easy Stand Evolv + Glider

<https://easystand.com>

STRENGTHENING/ RESISTANCE EQUIPMENT

The following are examples of equipment that are readily found in a local gym or rehab center which can be used by individuals with SCI for strengthening exercises. Seating and hand adaptations or modifications may be needed depending on level and completeness of injury. It is important to note that regular weights/ dumbbells and therabands can also be used. See our home work out section for more details.



Freemotion Dual Cable Cross

<https://freemotionfitness.com/strength-machines/genesis>



**Matrix Functional Trainer
G3-MSFT300/400**

<https://www.matrixfitness.com/en/strength/multi-station/g3-msft3-functional-trainer>



ADL Leg Press

<https://www.adlbalance.com/products/adl-leg-press>

ADL Leg Press Photo taken by Madelyn Haas (2018)



Ergo Arm Skate by Therafin

<http://www.therafin.com/therapy-exercise.htm>



StepOne Recumbent Stepper

<https://www.scifit.com/product/stepone>



**Swedish Sling Counter
Balance Arm Support System**

<https://www.usamedicalsurgical.com/swedish-helpparm-swedish-sling-arm-support-system>

HOCOMA ERIGO

(Integrated Functional Electrical Stimulation)

<https://www.hocoma.com/solutions/erigo>



GAIT TRAINING EQUIPMENT

There are many different devices to provide offloading of body weight in order to facilitate gait training after SCI/D. Below are just a sample of the products available currently on the market. Some are free-standing and some require an overhead track for use. Additionally, some newer systems have integrated dynamic offloading.



**Rifton Transfer and Mobility
Gait Pacer**

<https://www.rifton.com>



Hocoma Lokomat

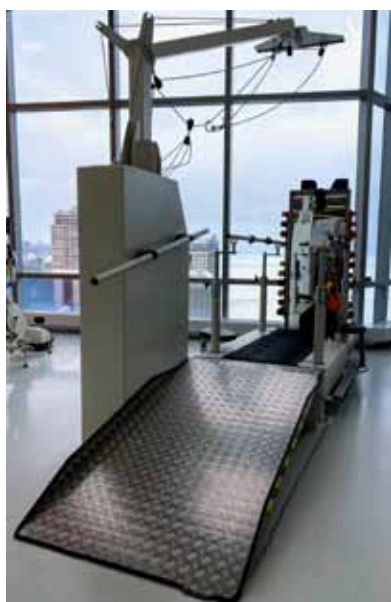
<https://www.hocoma.com/media-center/media-images/lokomat>



Alter-G

"Anti-Gravity Treadmill"

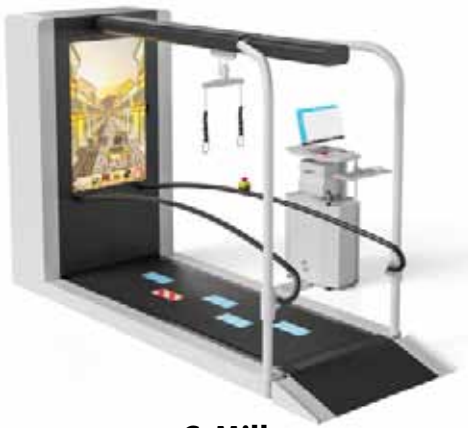
<https://www.alterg.com>



Woodway Loko Station

<https://www.woodway.com/products/loko-station>





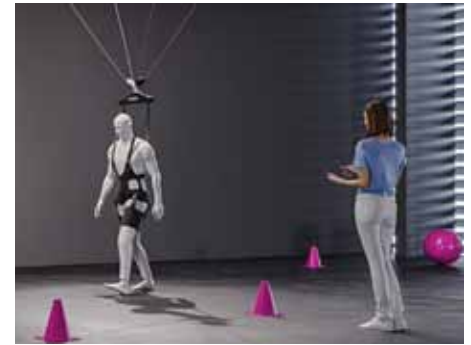
C-Mill

<https://www.motekmedical.com>



ZeroG Gait and Balance System

<https://www.aretechllc.com>



Motek Rysen

<https://www.motekmedical.com>



Rewalk Exoskeleton

<https://rewalk.com>

Ekso Bionics

<https://eksobionics.com>

ADAPTIVE EQUIPMENT

Adaptive equipment can be utilized on a variety of machines especially for individuals with tetraplegia who have poor hand function.

Active Hands

(Looped Gripping Aid)

<https://www.activehands.com/product/looped-exercise-aids>

Active Hands

(General Purpose Gripping Aid)

<https://www.activehands.com/product/general-purpose-gripping-aid>

Bike-On.com

<https://bike-on.com>

BALANCE / STANDING FRAME EQUIPMENT



Biodex Balance System™ SD
Biodex Medical Systems, Inc.
www.biodex.com



Thera Trainer Balo
<https://www.thera-trainer.de>



Thera Trainer Verto
<https://www.thera-trainer.de>



EASY STAND EVOLV

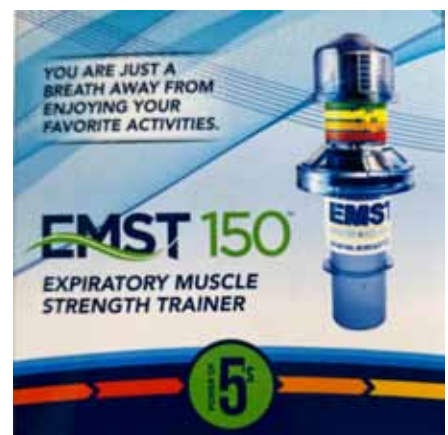
<https://easystand.com/product/png50162-evolv-medium>

RESPIRATORY MUSCLE STRENGTHENING

In addition to cardiovascular strengthening, respiratory muscle strengthening is essential especially for persons with cervical or high thoracic spinal cord injuries. RMT can improve vital capacity and respiratory muscles strength, and potentially decrease pulmonary infections. In addition, improvement in respiratory function may also improve cardiac and exercise function in general. Some pieces of respiratory strengthening equipment can be used in the hospital or home setting and can target either inspiratory muscles, expiratory muscles, or both depending on the device.

OTHER RESOURCES

There are a plethora of resources for alternative exercise equipment for individuals with SCI/D. We have highlighted the most commonly seen pieces of equipment at gyms and inpatient rehabilitation centers, but wanted to include other resources that may be helpful for this population. The following links provide information on other available fitness equipment, many of which can be easily added to personal home gyms.



Expiratory Muscle Strength Trainer
<https://emst150.com>

COMPACT FES DEVICES



Bioness H200

http://www.bioness.com/Products/H200_for_Hand_Paralysis.php

Bioness L300

<http://www.bioness.com/Products.php>



Below are examples of adaptive devices for upper and lower extremity FES cycling that enable targeted selection of muscle groups including the shoulder, upper extremities, core/trunk and the lower extremities.



RT300 for Leg and Core

<https://restorative-therapies.com/ifes-systems/rt300-leg-core>

MyoCycle by MYOLYN, LLC

<https://myolyn.com>



FUNCTIONAL ELECTRICAL STIMULATION

Electrical stimulation (ES) has been studied using many different approaches. This section will focus on transdermal electrical stimulation which generates contractions in paralyzed muscles by emitting electrical impulses of varying duration and magnitude via surface electrodes. Functional electrical stimulation (FES) combines electrical stimulation with a functional movement such as walking, grasping, or cycling.^{56,57,58} There are many different types of equipment currently out in the market that utilize FES technology and no documented differences in functional outcomes between manufactures. There are compact FES devices with site specific stimulation of muscles in both the upper and lower extremities, and larger pieces of equipment which can be used in conjunction with FES devices in order to allow for leg cycling, leg exercises, rowing, arm ergometry, electrically stimulated standing or electrically stimulated bipedal ambulation with or without an orthosis.^{1,59}

There are numerous benefits of a consistent FES exercise programs in persons with spinal cord injury including increased muscle mass, decreased spasticity, improved bone health, increased cardiac mass in persons with tetraplegia, decreased blood pooling in lower extremities, increased blood return to the heart, increased HDL, decreased TG, LDL and total cholesterol, improved gas exchange kinetics with increased oxygen uptake, improved glucose tolerance and insulin sensitivity, and improved self-image.^{32,45,59,60,61,62,63,64,65,66,67,68,69,70}

Before embarking on an FES training program, individuals should be evaluated and cleared by a physician and therapist knowledgeable in spinal cord injury and FES as there are some relative contraindications for use. Some of these include placement over implanted devices, placement over blood clots or wounds, fractures, pregnancy, heart failure, metastatic cancer, and lower motor neuron injuries.^{71,72}

FITNESS AT HOME, THE GYM, AND THE COMMUNITY

Continuing a fitness regimen beyond the rehabilitation phase is extremely important for SCI individuals. Developing a tailored fitness regimen can be accomplished by creating a home work out plan, going to the gym, taking fitness classes, or participating in adaptive sports and recreation.

HOME WORKOUT PROGRAM

Many of the pieces of equipment listed above may be space or cost prohibitive for individuals to have in their own homes. In addition, many individuals with SCI/D are unable to access fitness centers outside of their home for many reasons including medical limitation, transportation availability, local gym availability, and quarantine. Recently, there has been an explosion of available virtual exercise classes, phone applications, social media instructional videos, and online communities that provide fitness and wellness tips at home. Below are examples of affordable and compact exercise equipment as well as online fitness resources that SCI/D individuals can utilize for their home workout program.

AFFORDABLE HOME EXERCISE EQUIPMENT



Balance Ball

<https://shop.lifefitness.com>



Bosu Ball

<https://www.bosu.com>



Balance Disc

<https://www.rehabmart.com>



Theraband

<https://www.theraband.com>



Dumbbell

<https://www.physicalcompany.co.uk>



Synergee Ankle/Wrist Weights

<https://iheartsynergee.com/products/synergee-ankle-and-wrist-weights>

Table 3: Online and Social Media Resources for SCI Fitness

Here are some tips and resources on how to expand a home based fitness and wellness program with available online resources.

| | |
|--|---|
| Search for Information on SCI and Fitness from Trusted Sources | <ul style="list-style-type: none"> • Northwest Regional Spinal Cord Injury System - Get Moving: Exercise and SCI https://sci.washington.edu/info/forums/reports/exercise_2013.asp • The Miami Project - Exercise https://www.themiamiproject.org/resources/healthy-lifestyle/exercise • Shepherd Center - Introduction to Exercise after Spinal Cord Injury https://www.myshepherdconnection.org/sci/home-exercises • National Center on Physical Activity and Disability - 14 Weeks to a Healthier You Program – https://www.nchpad.org/14weeks • The Ohio State University - Arm Exercises for Spinal Cord Injury http://www.sld.cu/galerias/pdf/sitios/rehabilitacion/arm_exercises_for_spinal_cord_injury.pdf • Flint Rehab - The Ultimate Home Exercise Program for Spinal Cord Injury Patients – https://www.flintrehab.com/home-exercise-program-for-spinal-cord-injury • ICORD - Physical Activity Research Centre http://icord.org/parc/exercise-resources/#Guidelines |
| Explore the Web for Online Health and Wellness Activities and Virtual Community Programs | <ul style="list-style-type: none"> • Wheely Good Fitness – https://wheelygoodfitness.com • Invictus Active – https://www.invictusactive.com • SCI Total Fitness – https://www.scitotalfitness.com • Gathering Strength – https://gatheringstrength.org |
| Follow Social Media for Online Videos and Virtual Classes (Look for these across social media platforms!) | <ul style="list-style-type: none"> • Invictus Active - Youtube Channel – https://www.youtube.com/channel/UC3eMS-zHJlTHw9RkexMyw6w/videos • Every Body Fitness - Youtube Channel – https://www.youtube.com/channel/UCff18PfI7dsLIZ1mxN8NI-A/featured • Healthy Tomorrow - Rehabilitation Research and Training Center (RRTC) on Secondary Conditions in the Rehabilitation of Individual with Spinal Cord Injury (SCI) - Youtube Channel – https://www.youtube.com/c/HealthyTomorrow/about • Bay Area Outreach & Recreation Program (BORP) Adaptive Sports - Youtube Channel – https://www.youtube.com/channel/UC9_UVGsJAwWcr3zoUJZ9e1g/featured • Shepherd Center -Youtube Channel – https://www.youtube.com/user/ShepherdCenter/featured • Spinal Cord Injury Research Evidence (SCIRE) - Youtube Channel – https://www.youtube.com/user/SCIREWebVideo/videos • Adapt to Perform - Youtube Channel – https://www.youtube.com/channel/UClosZzwrXmjPzDCwD9OcC0A • ICORD - Physical Activity Research Centre- Youtube Channel – https://www.youtube.com/channel/UCvZY8eLLIHWMrYIHtqq1x1w/featured |

GOING TO THE GYM

Table 4: Actions to take to find accessible gyms

Looking for a gym with the appropriate adaptive equipment and knowledgeable staff to assist in a gym based fitness program may be a daunting task for individuals with SCI/D. While these are known barriers to physical activity, individuals with SCI/D should be educated on the actions they can take to help them find the gym with the right fit or even encourage policy changes to make local gyms more accessible.

| | |
|--|---|
| Know your rights | <ul style="list-style-type: none">• Be familiar with the American Disabilities Act! Look for gyms that not only meet the ADA requirements for sports facilities but go beyond it. The US Access Board is responsible for issuing accessibility guidelines for newly constructed and altered recreation facilities. They establish the minimum accessibility requirements by providing specifications for sports facilities that ensures disabled individuals can utilize the space without any barriers.• Access Board - Sports Facilities website: https://www.access-board.gov/ada/guides/chapter-10-sports-facilities/#introduction• ADA website: https://www.ada.gov |
| Call your local gyms and ask questions | <ul style="list-style-type: none">• Tour the facility!• Ask questions to let staff know what your needs are:<ul style="list-style-type: none">• Does the gym follow the ADA requirements?• Do they have adaptive equipment?• Are there staff members who are familiar with wheelchair users and their fitness needs?• Are staff members trained on the medical sequelae of spinal cord injury?• Do they have specific trainers who have experience with people with disabilities? |
| Learn the equipment | <ul style="list-style-type: none">• Know the equipment highlighted earlier in the chapter, including what modifications/ adaptations are possible.• Ask if the gym has adaptive equipment available. |
| Speak up and make changes | <ul style="list-style-type: none">• Address the barriers or deficits in services with the staff/ management.• Follow up with specific changes in writing.• Be willing to file a complaint. |

If you cannot find an accessible gym in your area, there may be SCI specific organizations like Journey Forward and Next Step Fitness that may provide exercise programs for people with disabilities. Appealing to your local government to include adaptive exercise machines, accessible outdoor spaces, and adaptive sports equipment to municipally owned buildings and programs is another option.

SPORTS AND RECREATION

Fitness may extend beyond the gym setting. Sports for persons with disabilities started in England with Sir Ludwig Guttman at the Stoke Mandeville Hospital, utilizing sporting events to rehabilitate people with injuries from World War II. Since then, the number of both recreation and competitive adaptive sports

available for individuals with SCI has grown. Many individuals who were actively involved in sports prior to injury may be interested in a return to sporting. Those who may not have been involved in sports or recreation before may now be interested in becoming more active. Before an individual with SCI gets involved in sports and recreation activities, preparticipation screening is recommended to provide appropriate exercise prescription and to identify any conditions that may require special precautions or modifications to activities. Some individuals may need testing including bone mineral density scans to evaluate for fracture risk, pulmonary function testing, or exercise stress testing. It is important that individuals be counseled on the appropriate exercise prescription, and the risks and medical consequences to monitor prior to starting any sports activities.

Below is a sample list of the many types of sports/ recreation that are available for wheelchair users that can provide opportunities for exercise, wellness, as well as socialization and integration into the community.

Adaptive Sports/Recreation

- Archery
- Basketball
- Bowling
- Billiards
- Canoeing
- Flying
- Golf
- Hand Cycling
- Horseback Riding
- Hunting
- Para Dance Sport
- Power Soccer
- Rock Climbing
- Rowing
- Rugby
- Sailing
- Scuba
- Skateboarding
- Sled Hockey
- Snowboarding
- Snow Skiing
- Softball
- Surfing
- Swimming
- Track and Field
- Water Skiing
- Weight Lifting
- Wheelchair MotoCross
- Wheelchair Racing
- Wheelchair Tennis

Many of these sports/ recreational activities are available through state park programs, as well as community and nonprofit organizations at little to no cost. American public schools are required to offer physical education to every student and information about adaptive sports programs are available through local school districts. In addition, many of these activities can also be pursued on a competitive level, based on functional ability, and individuals with SCI/D, may be able to continue to collegiate or professional level sports.

Table 5 is a list of organizations with their respective websites with information on how to get involved in both recreational and competitive sports, as well as how to connect with companies that can provide adaptive sports equipment. Some other resources that may be helpful include: BlazeSports America (www.blazesports.org) and Adaptive Sports, USA (www.adaptivesportsusa.org), both of which provide information on adaptive sports and recreational programs regionally and internationally. Individuals who need financial support to procure adaptive equipment can go to The Challenged Athletes

EXAMPLES OF ADAPTIVE SPORTS EQUIPMENT



Table 5: Websites for Recreational and Competitive Sports Organizations in the USA

| Recreational Sports | | Competitive Sports | |
|---|---|--|--|
| Sport/ Activity | Website | Sport/ Activity | Website |
| Aerobics; Disabled, Sports USA; Sailing, National Ocean Access Project | www.dsuas.org / www.dsua.org | US Paralympics Sports Clubs | www.findaclub.usparalympics.org |
| American Canoe Association | www.acanet.org | Wheelchair Athletics/ Archery/ Table Tennis Federation/ Softball | www.wsusa.org |
| Bowling, American Wheelchair Bowling Association | www.amwheelchairbowl.qpg.com | National Wheelchair Basketball Association | www.nwba.org |
| Billiards, National Wheelchair Billiards | www.nwpainc.com | International Wheelchair Basketball Federation | www.iwbf.org |
| Camping, National Park Services, Office of Special Programs | www.nps.gov | US Fencing Association | www.usfa.org |
| Flying, International Wheelchair Aviators | www.wheelchairaviators.org | Association of Disabled American Golfers | www.toski.com/golf/adag |
| Freedom's Wings International | www.freedomswings.org | American Handcycle Association | www.ushf.org |
| Fishing, PVA | www.pva.com | American Sled Hockey Association | www.sledhockey.org |
| Handicapped Scuba Association | www.hsascuba.com | US Quad Rugby Association | www.quadrugby.com |
| Horseback Riding, North American Riding for the Handicapped Association | www.narha.org | International Wheelchair Tennis Federation | www.ifttennis.org |
| Hunting, NRA Disabled Shooting Services | www.nrahq.org | US Wheelchair Swimming | www.usa-swimming.org |
| Special Olympics International | www.specialolympics.org | | |
| US Rowing Association | www.usrowing.org | | |
| US Wheelchair Swimming Inc. | www.wsusa.org | | |
| Water Sports, American Water Ski Association | www.usawaterski.org | | |

Foundation (www.challengedathletes.org) and the Kelly Brush Foundation (www.kellybrushfoundation.org) to find information on applying for grants.

In addition to the above sports and recreation activities, there has been a growing interest in other fitness activities like wheelchair yoga, pilates, Tai-Chi, Zumba classes, and more recently, wheelchair dancing. There are now virtual and live community classes as well as programs on social media available as the fitness community continues to integrate with the disability community. The following are resources for more information on these activities.

Wheelchair Dance

Axis Dance: <https://www.axisdance.org>
Dancing Wheels: <https://dancingwheels.org>
Full Radius Dance: <https://fullradiusdance.org>

Wheelchair Yoga

NCHPAD Yoga: <https://www.nchpad.org/295/1834/Yoga~for~Individuals~with~Disabilities>
Christopher Reeve - Yoga: <https://www.christopherreeve.org/living-with-paralysis/health/staying-active/video-series-yoga-for-your-health>
Accessible Yoga Association: <https://accessibleyoga.org>

Adaptive Tai Chi

Adaptive Tai Chi International: <http://adaptivetaichi.org>

CONCLUSION

Fitness and wellness is an important component of life post spinal cord injury. All health care providers should encourage and educate their patients on the benefits of exercise due the cardiovascular and metabolic sequelae of SCI and early mobilization should be initiated once a patient is stable. As they move through the rehabilitation phase, individuals with SCI/D should be able to recognize the signs, symptoms and physiologic basis of medical consequences like orthostatic hypotension, autonomic dysreflexia, and thermoregulation issues as well as be able to take the appropriate steps to resolving these issues including instructing others in assisting them. In addition, SCI individuals should be educated on the basic principles of fitness and establish an exercise program to which they can adhere. This not only leads to the preventing cardiometabolic risks often seen with a sedentary lifestyle, but also improves overall quality of life. With the advent of new technology, innovation in bringing fitness programs to an individual’s home, and the variety of resources on the internet and social media, achieving and maintaining physical fitness for SCI individuals is more possible now more than ever. Ongoing research is needed to define the optimal amount, type and intensity of exercise needed for the best functional outcomes and reduced morbidity and mortality in the SCI/D population.

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