Chapter Three

Guidelines for the Clinician for Development of Fitness Programs for the Physically Challenged

by Sarah A. Morrison, PT

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INTRODUCTION

Consistent with the nondisabled population, cardiorespiratory disease is one of the leading causes of death in the spinal cord injury (SCI) population (1). As a result, there is an ever-growing need for physical fitness for individuals with SCI. The primary and secondary cardiorespiratory complications that occur as a result of SCI were discussed in detail in Chapter One.

Because of numerous health risks associated with a strenuous exercise program, wheelchair users should have a medical and fitness evaluation prior to beginning such a program. As late as 1972, individuals with injury levels higher than T6 were strongly discouraged by medical authorities from participating in endurance training due to suspected medical risks associated with autonomic deficiency (2). More recently, however, the physiological responses to exercise in persons with SCI have been widely researched and this medical concern no longer exists.

The psychological benefits of exercise supported by medical research studies for individuals with SCI are limited. These studies have shown that aerobic exercise increases self-esteem, improves employment opportunities, increases participation in social activities, decreases depression, increases confidence in coping with daily problems and increases a sense of well-being (3,4). The documented physical benefits as a result of regular exercise for the SCI population are an improvement in functional capacities, an increased efficiency in performing activities of daily living, and a decrease in related hospitalizations (3,5,6).

This chapter will address the research-related testing and training techniques developed specifically for persons with spinal cord injury. The various testing equipment, protocols, training programs, and other developed techniques will be discussed.

As stated earlier, a thorough medical and fitness evaluation should always be performed at the local VA Medical Center prior to establishing an exercise program. In addition, a baseline of fitness should be established in order to appropriately suggest an exercise program that best suits the person and will be of maximal benefit to him or her.

RECOMMENDED TESTING EQUIPMENT FOR MEDICAL/PARAMEDICAL PERSONNEL USE

Upper Limb Ergometers

Currently, upper limb ergometers are the most reliable and valid testing modes for objective clinical and functional evaluation of exercise performance and for optimal prescription of individualized exercise training programs in SCI persons (7). Because of lower limb paralysis, alternative modes of exercise testing must be used, which utilize the spared upper limb musculature. There are three upper limb exercise modes that are commonly utilized for the testing/training of individuals with SCI: arm crank ergometry (ACE), wheelchair ergometry (WERG), wheelchair propulsion on a treadmill (WTM), and soon, wheelchair aerobic training (WAFT).

Arm crank ergometry (**Figure 1**) uses a cycling motion with the upper limbs. The ACE is commercially available in three different models: a modified Monarch cycle ergometer, an electromagnetically braked ergometer, or a portable arm crank device (e.g. Cybex Upper Body Ergometer, Schwinn Air-Dyne Ergometer, or the Monarch upper limb trainer).

The primary advantage of arm crank ergometry is that it is relatively inexpensive, easy to modify, and can also quantify work rate. Any lower limb cycle in a clinic can be utilized for upper limb testing by securing the cycle to the top of a sturdy table. The primary disadvantage of arm crank ergometry is that it requires different biomechanics from those for propelling a wheelchair. In addition, because it requires a fairly good hand grip, it is difficult for use by individuals with tetraplegia. "Flexion mitts" are available to promote a strong hand grip or to create an artificial grip, (**Figure 2**).

Unlike arm crank ergometry, wheelchair ergometry has the advantage of following the rules of specificity training due to its operation, which is similar to that of a wheelchair. Wheelchair ergometry is designed based on principles similar to those used by the Monarch cycle ergometer. The wheel-coupling unit of a wheelchair is connected to a high-inertia flywheel (**Figure 3**). The work rate is modified by adjusting either the tension in the braking strap around the flywheel or by adjusting the push rim velocity. The primary advantage of wheelchair ergometry, other than the specificity training, is that it is relatively inexpensive and can also accurately quantify the work rate (power output). Unfortunately, WERG and WAFT are not yet commercially available and must be designed and constructed.

Similar to wheelchair ergometry, wheelchair propulsion on a treadmill (propelling a wheelchair on a motor-driven treadmill) also utilizes the rules of specificity. The treadmill is modified to accommodate the width of the wheelchair and is usually equipped with side guards to control the lateral motion of the

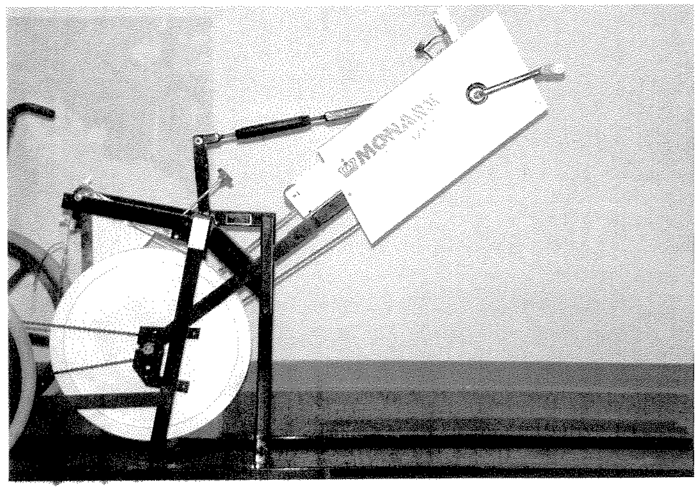


Figure 1.
Arm crank ergometer.

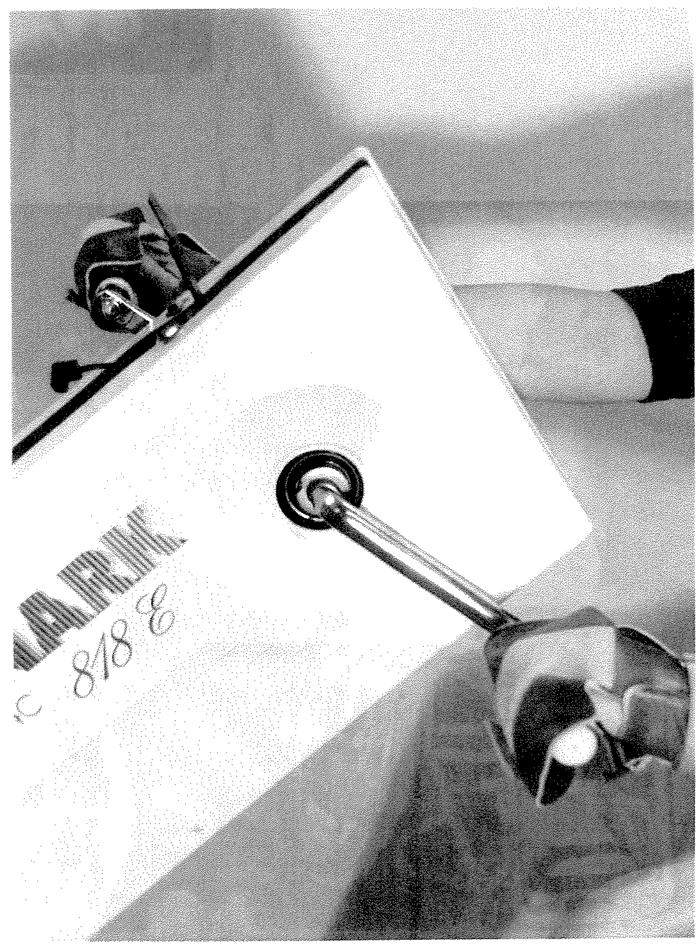


Figure 2.
Flexion mitts.

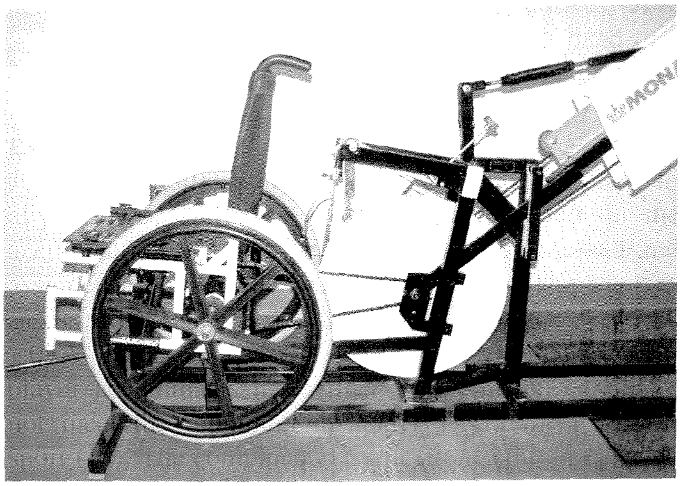


Figure 3.
Wheelchair ergometer.

wheelchair. Work levels on the treadmill can be determined by either increasing the grade of the incline, the speed of the belt, or through a combination of both.

A comparison of test results of the upper limb ergometers for individuals with SCI shows a variety of differences in peak physiological parameters. Gass and Camp (8) reported a higher peak oxygen consumption, carbon dioxide output, heart rate, and expired volume with wheelchair ergometry as compared to arm crank ergometry. Wicks (9) concluded that at any given power output, subjects attained a lower cardiac output with lower values for both heart rate and stroke volume when using arm crank ergometry versus wheelchair ergometry. Glaser (10) determined that arm crank ergometry elicited significantly higher peak heart rates, power outputs, and blood lactate levels as compared to wheelchair ergometry. A study by Pittetti (11) compared exercise responses elicited by four different upper limb ergometers and found minimal significant differences between the devices. Preliminary results of a 1994 research project at Shepherd Center in Atlanta, Georgia indicate no significant difference between the two exercise modes, with the exception of a higher peak power output achieved for subjects with paraplegia.

All of the studies discussed above concluded that the devices studied are capable of evaluating a maximal exercise response for individuals with SCI. Research has shown that ACE, WERG, or WTM are all acceptable devices for testing persons with SCI.

Computerized Functional Electrical Stimulation

Another, although less popular, method of exercise testing is computerized functional electrical stimulation to the lower limbs (CFESLL) to simulate leg cycle ergometry. Electrical stimulation is applied to the skin of the gluteus maximus muscles, and quadricep, and hamstring musculature, in the correct sequence to cause lower limb cycling. The scientific basis for using CFESLL is to increase exercising muscle mass, facilitate venous return to the heart, and thus, increase the circulatory blood volume. CFESLL has been shown to be more effective than arm crank ergometry for cardiac volume-loading. In addition, at equivalent oxygen consumption levels, stroke volume and cardiac output are significantly higher during CFESLL as compared to the use of arm crank ergometry (12–14). These results are consistent for all levels of injury (14). The disadvantage of using CFESLL is the high cost of the equipment, the time and personnel required to complete the test, and the risk of physical injury (burns), fractures of the lower limbs, and increases in spasticity (15).

CFESLL has also been studied in conjunction with arm crank ergometry (''hybrid'' exercise). The purpose of performing both modes of exercise simultaneously is to further increase the working muscle mass in order to 1) create higher levels of metabolic and cardiopulmonary responses, 2) increase venous return to the heart, and 3) increase blood flow (16). Research results show that compared to arm crank ergometry alone, the hybrid exercise can improve oxygen consumption by 35 percent oxygen saturation by 46 percent, stroke volume by 26 percent, and peak heart rate response by 18 percent in subjects with tetraplegia (16). Subjects with paraplegia responded to CFESLL with an increased oxygen consumption, but with little or no increment in peak oxygen consumption, suggesting central circulatory limitations during peak hybrid exercise (1). The disadvantage to hybrid exercise testing is the high cost of the equipment, making it difficult for clinics to own this particular piece of equipment. Also, hybrid exercise has been known to increase the risk and degree of exercise hypotension, especially for persons with tetraplegia (16).

Lower Body Positive Pressure Suits

Lower body positive pressure suits are placed over the lower limbs and abdomen area. Pressures in the suit fluctuate in an attempt to mimic the muscle pump activities of the lower body musculature. Similar to the use of CFESLL, the medical goal of utilizing the lower body positive pressure suits is decreasing leg venous pooling and increasing circulating blood volumes during exercise. The first studies that evaluated the effectiveness of the lower body positive pressure suits were done by Vallbona (17) and Huang (18). The results of their studies revealed that orthostatic hypotension could be prevented in persons with tetraplegia through the use of leg and abdominal pneumatic devices. Hopman (19) took this idea one step further and researched the effects of an anti-G suit on cardiovascular responses to upper limb exercise in persons with paraplegia. Results of this study showed that there was an increase in pre-exercise blood pressure and decreased heart rate at similar submaximal workloads.

Research results of a lower body positive pressure suit testing study by Pittetti (20) showed increased oxygen consumption, increased pulmonary ventilation, increased stroke volume at 50 percent peak oxygen consumption, decreased submaximal heart rate, and a higher recovery of mean arterial blood pressure response. The results of this study suggest that for individuals with SCI, lower body positive pressure enhances the exercise capacity by preventing venous pooling in the lower limbs during upper limb exercise.

TESTING PROTOCOLS

Continuous Versus Discontinuous

Testing protocols vary for using a continuous versus a discontinuous test. The dispute over whether to use a continuous or discontinuous testing protocol is discussed in the literature (21–23). Sawka, et al. (21) recorded a higher maximal output using a discontinuous protocol. Walker (22) reported higher values for peak oxygen consumption and maximal power output also using a discontinuous protocol. Olle (23) found that a discontinuous protocol resulted in a significantly higher peak heart rate, lower peak power output, and increased time to complete a test. It appears that either a discontinuous or a continuous protocol is able to determine an appropriate peak oxygen consumption, pulmonary ventilation, and respiratory exchange ratio (RER). Subjects using continuous protocols have been noted to reach exhaustion in a very short time as compared to discontinuous protocols. Also, it is hypothesized that the effects of decreased blood flow to exercising muscles would be minimized by using a continuous protocol (22). On the other hand, a discontinuous protocol may help partially restore blood flow during the rest interval (21).

One advantage of a discontinuous test is that it appears to be better tolerated by the test subjects. It also permits the evaluator performing the test to more closely monitor blood pressure responses throughout the testing procedure. However, in terms of saving time, the continuous protocol is favorable. For values obtained during a continuous versus a discontinuous test, refer to **Table 1**.

Supine Versus Sitting Position

The hypothesis for testing a subject in the supine position as opposed to the sitting position is that it promotes venous return back to the heart, thereby increasing central blood volume and stroke volume while reducing heart rate at equivalent submaximal work rates. Placing the subject in a supine position partially alleviates the effects of gravity on venous pooling, autonomic dysfunction, skeletal paralysis, lack of truncal support, and scapular stabilization. McLean (24) researched these two different testing positions in a group of 11 subjects with tetraplegia. Persons with tetraplegia who are tested in the supine position had an increase in power output of 16 percent, oxygen consumption of 15 percent, and pulmonary ventilation of 18 percent. Heart rate and rate of perceived exertion (RPE) were not influenced by body position. Hooker (25) compared responses to incremental supine and upright sitting arm crank ergometry in nine men with high-lesion paraplegia. The results of this study indicated exercise tolerance in persons with high-lesion paraple gia did not improve when arm crank ergometry was performed in the supine posture. The difference found

Table 1.
Discontinuous versus continuous testing protocol.

	Discont.	Cont.	Sig.
$\dot{V}O_2$ (l/min)	2.13	2.18	none
HR (bpm)	198	187	$p = .047$
$\dot{V}_E$ (l/min)	82.8	78.9	none
RER (l/min)	1.25	1.17	none
PO (Watts)	99.5	103.5	$p = .074$
Test Time (min)	44	7	$p = .000$

Discont. = Discontinuous
Cont. = Continuous
Sig. = Significance

in these two studies suggests that the supine position may be more beneficial for persons with tetraplegia.

TESTING VARIABLES

Variables to evaluate during an exercise test should include heart rate, arterial blood pressure, peak power output, and peak oxygen consumption. This allows the professional to monitor the subject's safety and provides a means for showing fitness status and/or improvement. Evaluating functional skills, such as wheelchair propulsion, is also recommended as a means to compare fitness levels to performance of functional abilities. Other variables that are often evaluated in the studies discussed in the literature include minute ventilation, stroke volume, cardiac output, mean arterial pressure, blood lactate levels, respiratory exchange ratio, percent body fat, and lipid profiles. However, more sophisticated and costly equipment and procedures are generally required to obtain these variables.

Heart rate can be monitored through a radial or carotid pulse. Access to an electrocardiograph (ECG) machine and/or telemetry unit will be helpful for continuous monitoring during testing protocols. If an ECG or telemetry unit cannot be obtained, utilize the pulse method. As discussed in the previous chapter, due to the impairment of heart rate response in the SCI subject, do not solely rely upon heart rate when designing a testing or training program.

Blood pressure is usually measured using the auscultatory technique. It is essential that blood pressure be monitored closely due to the hypotensive episodes that may occur during exercise. In order to prevent this response from occurring during testing/training sessions, the client should wear anti-embolism stockings and an appropriately fitting abdominal binder. Hydrating prior to testing may also be helpful.

Peak oxygen consumption is usually measured though the use of a metabolic or "met" cart (**Figure 4**). This is a reliable and valid way to measure oxygen consumption and pulmonary ventilation as well as tidal volumes, respiratory rate, metabolic equivalents, anaerobic threshold, and so forth. However, this piece of equipment is very costly. If available, a metabolic cart is the most accurate way to measure the respiratory and metabolic components of subjects with SCI during an exercise test.

In instances where technology is not available to measure oxygen consumption during exercise testing, there are still methods to establish oxygen consumption values. If utilizing a wheelchair ergometer or arm crank ergometer, a formula by Knuttson (26) uses work output to calculate oxygen consumption ($\dot{V}O_2$):

$$\dot{V}O_2 \text{ ml/min} = 3.06 * (\text{work}) + 191 \qquad [1]$$

A formula by Hartung (27) can be used to calculate oxygen consumption when testing subjects on a wheelchair treadmill where $\dot{V}_v$ is equal to the belt speed (m/min) * the grade (%/100). Mt is equal to the body mass (kg) + the wheelchair mass (kg) and $\dot{V}_h$ equals the belt speed (m/min):

$$\dot{V}O_2 \text{ ml/min} = 162 + 2.91\ (V_v+M_t) + 0.0658\ (V_hM_t) \qquad [2]$$

Franklin (28) has published results from utilizing a 12-minute modified Cooper field test to estimate aerobic capacity. A sustained 12-minute wheelchair propulsion task is shown to be a readily available tool in the evaluation of functional endurance for individuals with spinal cord injuries (6).

All three methods can be used to provide a quick and simple estimate of aerobic capacity. The advantages of using formulae for predicting oxygen consumption is that they are extremely inexpensive. An objective fitness test can be performed with only an ergometer or with a wheelchair and a stop watch. These methods will not be as accurate as the met cart. However, a comparison of the subject pre- and postexercise training can be objectively obtained. This will allow for establishment of objective and measurable goals during treatment.

Peak power output is the measurement of physical work capacity and is usually measured in watts or kilopon meters per minute (kpm/min). Power output is calculated based on the equipment that is being used. The calculation incorporates the revolutions per minute, the distance completed for each revolution, and the resistance that is applied to the testing apparatus. Drory, et al. (7) found that the higher the lesion of the spinal cord, the lower the peak power output. Peak power output ranged from 154 kpm/min in subjects with tetraplegia to 467 kpm/min in subjects with lumbar paraplegia.

EXPECTED TESTING RESULTS

Documented physiological results during a maximal exercise test vary depending on the level of injury, the device used to complete the test, the length of time postinjury, and the level of fitness of the subjects being tested. Refer to **Table 2** for mean values of peak oxygen

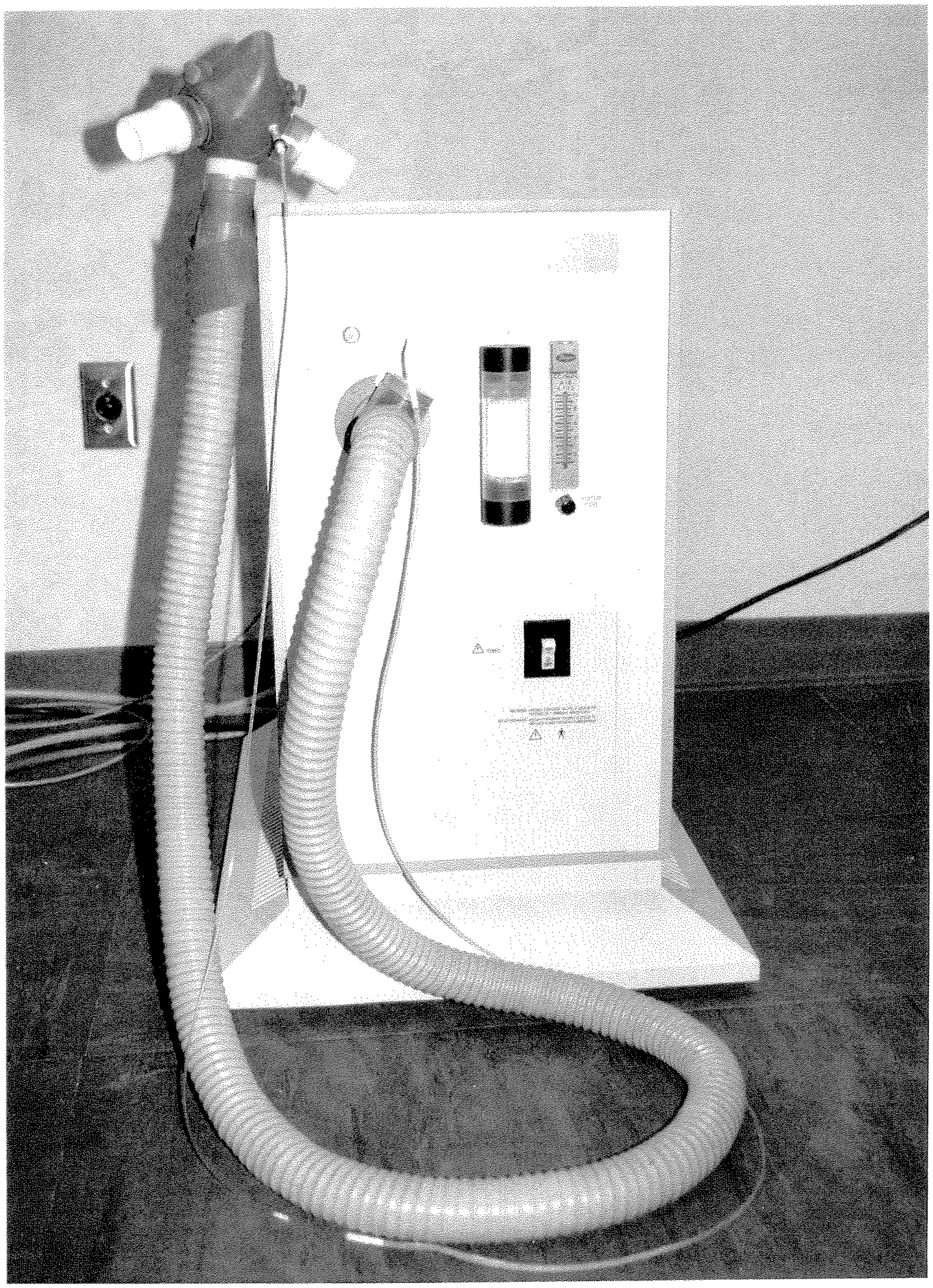


Figure 4.
Metabolic cart.

consumption, peak heart rate, blood pressure, blood lactate levels, and peak resistance for acutely (less than 3-months postinjury) injured persons with tetraplegia and paraplegia and their nondisabled counterparts. Refer to **Table 3** for results of a study done by Burkett (29) which evaluates the differences in heart rate, oxygen consumption, and respiratory exchange ratio for persons with tetraplegia and paraplegia (trained and untrained).

Table 2.
Peak physiological responses to arm exercise in an acute SCI population.

	Tetraplegia	Paraplegia	Nondisabled
Peak HR (bpm)	121	157	180
Peak $\dot{V}O_2$ (ml/kg/min)	9.8	13.6	40-60
Peak BP (mmHg)	97/66	130/76	190/70-80
Lactate (mmol/	3.0	4.5	10

Unpublished data from a study at Shepherd Center, funded by National Institute on Disability and Rehabilitation Research.

Table 3.
Exercise capacity of trained and untrained individuals with spinal cord injury.

	Tetraplegia Untrained	Paraplegia Untrained	Paraplegia Trained
HR (bpm)	134	181	160
$\dot{V}O_2$ (Ml/kg/min)	8.9	24.73	28.1
RER	1.14	1.24	1.24

ESTABLISHING A TRAINING PROGRAM

After a fitness test is completed, an appropriate exercise program should be established. Cardiorespiratory deconditioning in sedentary individuals with SCI can be reversed by implementing a regular exercise program (30). However, if training is terminated for as little as 2–4 weeks, deconditioning can occur rapidly (31). Exercise conditioning appears to be the only way to increase and maintain an optimal fitness level. Where appropriate, guidelines set forth by the American College of Sports Medicine (ACSM) are frequently utilized. However, due to the unique characteristics discussed in Chapter Two, these guidelines may not be appropriate. Exercise frequency, intensity, duration, and prevention of injuries will be discussed.

The frequency of exercise should be 3 times per week minimum and 6 times per week maximum. One to two days of rest may be incorporated to allow for recovery, assist in preventing burnout, and aid in the prevention of over-use syndromes of the relatively small upper limb mass.

With nondisabled individuals, it is common to establish an appropriate training intensity by having the subjects exercise at a percent of maximum heart rate or oxygen consumption. ACSM recommends that nondisabled persons train at 55–95 percent maximum heart rate or 45–85 percent maximum oxygen consumption. Establishing the appropriate intensity of exercise for persons with SCI is more complicated. Due to the autonomic dysfunction in the higher level of injuries, heart rate may not be an appropriate indicator of training intensity.

Persons with paraplegia and tetraplegia have demonstrated improvements in fitness levels when they engage in exercise programs using 50–60 percent of heart rate reserve (32,24). Hooker, et al.(25) reported that wheelchair ergometry training at 60–70 percent peak oxygen consumption significantly improved lipid profiles of subjects with paraplegia. When the autonomic nervous system is impaired, the Borg Rating of Perceived Exertion Scale (33) can be used to prescribe exercise intensity (**Figure 5**). The Borg scale is a 15-point scale that indicates how hard an individual feels he or she is working. It is recommended that training occur between 13 and 15.

Regardless of the intensity used, certain guidelines should be used (31):

1. Exercise should be performed at intensities greater than normally encountered during daily activities. [It has been reported by Hjeltnes (34) that daily activities utilize 15–24 percent of heart rate reserve during a normal day.]
2. Intensity should progressively increase as performance improves.
3. Once the goal of training has been achieved, periodic exercise at the final intensity/duration levels should be used to maintain fitness levels.

The duration of an exercise session should be between 20 and 60 minutes. It is important that the person begin exercises slowly. The initial duration should be individualized and gradually increased to achieve pre-established long-term goals.

Potential Symptoms of Over-exercise

Reported symptoms during exercise training have been described by Drory (7). Ninety-eight subjects were questioned on their reported symptoms during exercise sessions. Based upon the responses of the subjects, symptoms and percentage of symptoms depended heavily upon level of injury. See **Table 4** for the summarized results of this study.

Symptoms of exercise should be closely monitored. If a fluctuation or worsening of symptoms occurs, exercise should be discontinued and medical attention sought immediately.

6	
7	**Very, very light**
8	
9	**Very light**
10	
11	**Fairly light**
12	
13	**Somewhat hard**
14	
15	**Hard**
16	
17	**Very hard**
18	
19	**Very, very hard**
20	

Figure 5.
Borg Rating of Perceived Exertion Scale.
Reprinted from *Sports and Science* Vol. 14 No. 5, 1982:337–81. "Psychological basis of perceived exertion: Medicine and science," by GAV Borg.

Table 4.
Symptoms of exercise.

	Dizziness %	Fatigue %	Muscle Pain %	Shortness of Breath %
Cervical	26.7	93.3	20	6.7
T1-T5	15	35	20	5
T6-T12	5.1	33	12.8	0
Lumbar	0	29.4	5.9	0

INJURY PREVENTION

A vital determinant of how successful an exercise program for persons with spinal cord injury is depends upon injury prevention. Injuries may result in frustration, deconditioning, and, in some instances, hospitalization. In order to prevent injuries, a prescribed exercise program should include:

1. A proper warmup to prepare the muscles for exercise.
2. Stretching and flexibility exercises—most wheelchair events require excellent shoulder mobility.
3. Slow progression—do not rush. The progression of a program must be individualized and will depend on exercise capacity, health status, age, and personal goals.
4. The prevention of overheating by providing practical means of cooling (e.g., fans, water, air conditioning, avoiding exercise in extreme heat, and/or humidity, and so forth).
5. Protective equipment (e.g., helmet, padded gloves, foot straps, leg straps) to prevent traumatic injuries.
6. Various activities incorporated into the training program. This will allow for varying amounts of weightbearing to the shoulder joint. The variety will also offer excitement to the exercise program.
7. The nonuse of "boosting" techniques. Boosting is a self-induced autonomic dysreflexia used by some athletes to increase performance during competition. Boosting is usually accomplished through bladder overdistention. This technique can lead to dangerously high blood pressure and is discouraged for obvious medical reasons.

ESTABLISHING THE PROGRAM

Starting an exercise program for persons with SCI can be both inexpensive and rewarding. Many clinics, whether acute care, rehabilitation, extended care facilities, or home health, have the sufficient equipment to begin a basic exercise testing and training program. Many equipment items will already be located within the clinic. A few ideas are presented below:

1. Wrist weights or hand-held weights can be used for strengthening, as well as endurance-type activities.
2. A lower limb bicycle can easily be modified into an arm crank ergometer by mounting it on top of a table. Arm crank ergometers are also commercially available at varying costs.
3. Wheelchair rollers are inexpensive and allow individuals to propel indoors during inclement weather. During nice weather, the subject can propel his or her own wheelchair outdoors.
4. Exercise video tapes designed specifically for wheelchair users are available and can be a lot of fun with a larger group of people.
5. Aquatic exercise can be done if a pool is available.
6. Specialized weight equipment can be utilized at a relatively low cost.

The objective is to establish an exercise program for the individual with SCI, using what is available.

OUTPATIENT ISSUES

After discharge from an organized rehabilitation program, subjects return to a self-supervised maintenance program. As in the nondisabled population, continuing an exercise program requires self-discipline. The person with SCI must be educated on the benefits of exercise while he or she is an inpatient and exposed to as many exercise options as possible.

Available Resources

If staffing and/or equipment are lacking, educating the person with SCI about the various exercise resources is especially essential. Outpatient resources include local/national sports teams, local YMCAs, and local health clubs. Orienting the client to each of these options and beginning exercise training as an inpatient will provide the client with the necessary working knowledge so that upon discharge, the client can continue his or her exercise program. At this time, a recreation therapist can advise the person regarding active sports in which he or she can participate. The therapist may then introduce the client to sports.

Accessibility

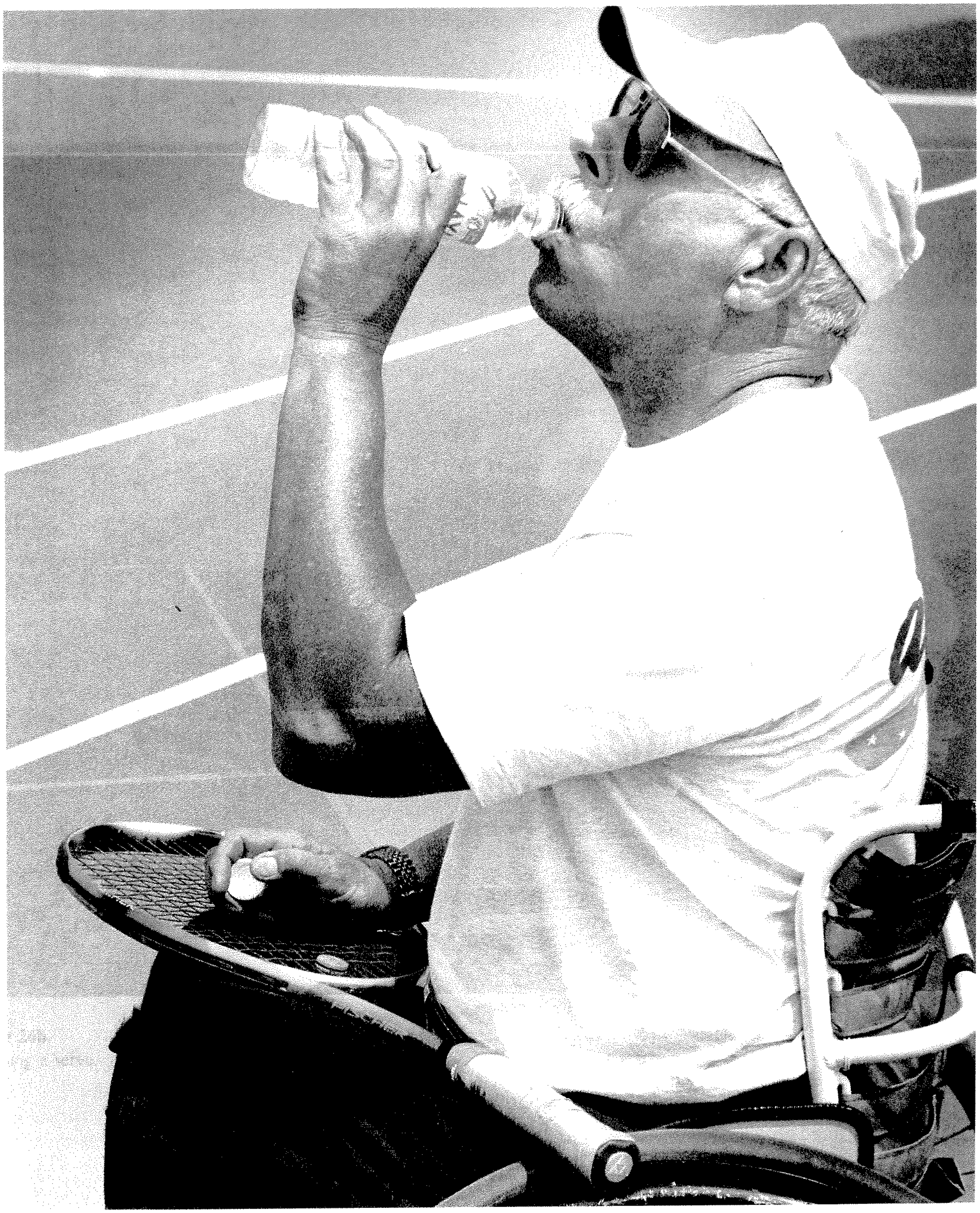
Accessibility to exercise facilities must be addressed. If an outing to a local health club is possible, a thorough evaluation of the facilities can be performed to assure the appropriateness of the facility. The equipment to be used must be well-padded. Due to the loss of sensation and the high risk of decubitus ulcers, it is imperative that sufficient padding be provided on all sitting surfaces. The client should be educated to perform complete skin checks before and after each exercise session.

The aisle width in the weight room must be adequate to enable the client to propel the wheelchair to each piece of equipment. The standard wheelchair is between 24 and 28 inches wide and requires a minimum of a 3-foot turning radius. The floor covering should be tile, or rubber if possible, to make wheelchair propulsion more efficient. Carpet can be fairly difficult to propel over, especially if the client has limited arm function.

Appropriately trained assistants are essential. The weight room technician must be educated as to the client's level of injury and as to what exercises and pieces of equipment should and should not be used. For example, a person with complete C5 tetraplegia should not perform exercises on a triceps machine. Also, the technician should be trained regarding the basics of what a spinal cord injury is and how exercise capacity may be affected. Appropriate action must be explained in the event of exercise hypotension or autonomic dysreflexia.

CONCLUSION

Regardless of the mode of testing or training used, the goal of an exercise regimen for the individual with SCI is to strengthen intact musculature, improve cardiovascular endurance, and prevent fatigue and deconditioning. If accomplished, activities of daily living can be performed more efficiently. The job of the professional is to provide basic fitness components to persons with SCI. This includes teaching the basic components of exercise as well as developing a fitness program for an inpatient that can continue for an outpatient. Through an exercise program, the person with SCI has the potential to increase quality of life, improve activities of daily living, decrease depression, and decrease the number of related hospitalizations. It is hoped that the integration of individuals with SCI into fitness programming will become the standard in all facilities.



Drink fluids often, in order to avoid dehydration.

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Figure 1.
Wheelchair push-ups.