IAAF @-*Letter*

for CECS Level II Coaches

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SPECIFIC THEME: Water running

GENERAL THEME: Recovery and regeneration

Specific Theme

WATER RUNNING

1 Introduction

Primarily seen as a method to rehabilitate injured athletes, water (or aqua) running in the deep end of the pool (deep-water running) has now taken on many other valuable roles (cf. McFarlane, 1993a, p. 3928).

Water running
• is done by a lot of athletes to recover from heavy training loads because it is non-weight bearing loading and therefore reduces stress and trauma on legs;
• offers an alternative program to do while injured;
• increases strength and flexibility as one works against a constant resistance and promotes cardiovascular fitness at the same time;
• adds variety to any program (aerobically and anaerobically).

The types of athletes who have benefited from using water running are many and varied, including middle and long-distance runners (cf. Lucas, 1996).

Also, (deep-)water running is the most biomechanically specific form of cross training for runners.[1] This means that (deep-)water running more closely simulates actual running than other forms of exercise (cf. Wilder, 2000).

2 Similarities and differences between deep-water running and on-land running

Deep-water running has been designed to closely follow normal on-land running, so naturally there are similarities. However, the environment is different enough to provide many differences (cf. Lucas, 1996, p. 16).

[1] Cross training will be dealt with in detail in one of the next issues of the @-*Letter*.

Some of the similarities (to on-land running) are:
• same running action,
• same workouts,
• similar training effects,
• same intensity possible.
Some of the differences are:
• an always stable environment (e.g. constant temperature),
• greater strength required,
• slower or faster stride frequency and sometimes much longer or shorter strides,
• no recovery phase in the running stride,
• shorter recovery between reps, sets, and workouts,
• technique faults are magnified and can therefore be more easily seen and corrected.

3 Equipment

Products such as the *Wet Vest* and *Aqua Jogger* are specifically designed for deep-water running. The *Aqua Jogger* is a fixed size (one size fits all), is convenient and easy to wear, but is less effective for larger, heavier athletes because of its constant buoyancy factor. Life jackets are generally unsuitable because they fit badly and most seem to restrict arm movement.

The great advantage of float devices is that they allow the athlete to learn the proper running styles without having to keep themselves afloat. On the other hand, float devices like the *Aqua Jogger* need to be worn tightly which can constrict breathing in some athletes (cf. Stern, 1995, p. 20; Lucas, 1996, pp. 17-18).

4 Techniques

To maintain proper form during deep-water running the following guidelines should be observed:

- Training is done in the deep end of the pool or in a diving well.
- The float belt should keep the athlete above water at approximately neck level. The mouth should be comfortably out of the water without having to tilt the head back. The head should be looking straight ahead, not down.
- The body should assume a position slightly forward of the vertical, with the spine maintained in a neutral position. The common error of leaning too far forward must be avoided.
- Arm motion is identical to that used on land, with primary motion at the shoulder. Hands are held tightly clenched.
- Hip flexion should reach approximately 60-80 degrees. As the hip is being flexed, the leg is extended at the knee (from the flexed position). When end hip flexion is reached, the lower leg should be perpendicular to the horizontal. The hip and knee are then extended together, the knee reaching full extension when the hip is in a neutral position (0 degrees of flexion). As the hip is extended, the leg is flexed at the knee. The cycle then repeats itself. Dorsiflexion and plantarflexion occur throughout the

cycle. The ankle is in a dorsiflexed position when the hip is in a neutral position and the leg is extended at the knee. Plantarflexion is assumed as the hip is extended and the leg flexed. Dorsiflexion is reassumed as the hip is flexed and the leg extended. Underwater viewing has shown that inversion and eversion will accompany dorsiflexion and plantarflexion, as it does with land-based running (cf. Craig, 1991, p. 35; Wilder, 2000).

The techniques of deep-water running can be divided into the *basic technique* and *advanced techniques*. However, before attempting one of the advanced techniques (see ch. 4.2) the basic technique must be mastered.

4.1 Basic technique

This technique is similar to jogging (recovery running). The idea is to reach out with the leading leg and pull through the water strongly and evenly. At the same time, the trailing leg needs to be actively pulled forward because of the increased resistance of the water. The front foot should "land" in front of the body's center of gravity (C.G.). The knees should be kept "low" and the foot should be actively flexed at "take-off".

The basic technique has two main purposes:

- to provide a sound platform from which to learn and execute the advanced techniques properly;
- to give the athlete an endurance training effect. Depending on the amount of time spent, this ranges from simple recovery running through to building significant endurance and strength endurance (cf. Lucas, 1996, p. 17).

An athlete's stride length and frequency in the water are very different when compared to the equivalent one on land. In general, frequency is slower for stride styles that have a significant strength or endurance component, but faster for those which are more speed-related when compared to on-land running.

Stride length in deep-water running can be much longer than for equivalent on-land stride frequencies for stride styles that have a significant strength or endurance component, but are necessarily shorter for those that are more speed-related. As a guide most athletes take between 45 and 65 double strides for 200 m on-land running (cf. Lucas, 1996, p. 17).

4.2 Advanced techniques

While the basic technique is fine for simple recovery, there are many more training effects that can be achieved with deep-water running. Great demands can be placed on the cardiorespiratory system (anaerobic workouts), dynamic flexibility can be improved, and specific muscle group work can be done.

The advanced techniques to achieve these effects are:

- max speed,
- heel lift,
- high knees, and
- middle stride (cf. Lucas, 1996, pp. 19-20).

Max speed

This technique is simply to make the legs go as fast as possible. The strides are kept as short as the athlete can make them. The legs are moved up and down with the “landing” slightly behind the C.G. The arms need to be in a normal maximal speed-running style.

Heel lift

Here, the upper leg should be kept as still as possible while flexing the lower leg. This is just like a hamstring curl but upright. It is difficult for the athlete to achieve full flexion and great concentration is required to perform this technique properly. If done correctly, there is a slight tendency for the athlete to move backwards in the water but this is normal (for this stride only). The hands can be used to prevent this and to stabilize the body.

High knees

In this technique the athlete is required to drive the leading leg up as high as possible with little emphasis on the trailing leg. A slight forward lean is recommended with the trailing leg “landing” significantly behind the C.G. and the arms definitely needing to be very active.

Middle stride

This is the most difficult pattern to learn and is used in the most demanding workouts. It should mimic the running style of a 400-800m runner with the leading leg “landing” slightly in front of the C. G. The trailing leg must be strongly curled up at the back of the stride to reduce the force needed to bring the leg forward again. The arms must be vigorously used. A great deal of strength is needed to do this with any speed at all.

5 Recovery

In general, much longer exercise duration can be achieved for any athlete in the water than on land and with much less recovery time needed between workouts. This seems to be due to the lack of eccentric contractions in the “landing” phase of the running stride in deep-water running. The recovery times seem to lie somewhere between those recommended for swimming workouts (which are very short) to those for on-land workouts. Simply put, recoveries for deep-water running workouts are shorter (cf. Lucas, 1996, p. 18).

6 Workouts

Before entering the water, it is important to warm up properly with general flexibility exercises and a short jog (McFarlane, 1993b, p. 49).

By judiciously combining stride style, frequency and, of course, recovery, a great range of neuromuscular, cardiovascular and cardio-respiratory responses can be obtained. Determining specific workouts for deep-water running intervals is a complex task.

As with land-based interval workouts, deep-water running intervals are a combination of distance and duration (to give intensity) and recovery. In on-land interval training, distance is normally used as the control variable and duration (time) is measured to evaluate the effect of the workout. In the water, measuring distance is too crude and inaccurate to be effective. Instead, the number of strides can be taken as the control variable with time still being used as the evaluative measure.

As a definition, a double stride occurs each time the right/left leg returns to the same position on the running stride. For example, every time the right leg strikes the ground it is counted as a double stride. This is then used to count strides for workouts. For example, an athlete takes 30 double strides to run 100 m in competition. Then, if the athlete shall duplicate doing an interval workout consisting of 100 m repetitions in the water, it must be timed how long it takes to do 30 strides.

Endurance (sub-maximal aerobic) workouts have the slowest stride frequency (slower than on land) and use the basic technique. They are roughly equivalent to recovery runs and, depending on the frequency, perhaps tempo runs. The hardest thing about these workouts is the time they take. Depending upon the athlete, the duration of these runs can be three hours or longer. In general, much longer duration can be sustained in the water than on land.

The basic idea of speed workouts in the water is to make the legs go as fast as possible. The stride pattern used here is max speed. It is the only workout type for which the stride frequency is faster in the water than its equivalent on land. In general, the number of strides for each interval is low (i. e. less than 30; cf. Lucas, 1996, p. 21).

7 Transition

Returning to normal training from total deep-water running needs particular attention. Some athletes describe a feeling of being sluggish and slow returning to land but this can be overcome to some extent by ensuring that appropriate stride frequencies are used as part of the deep-water running program.

SAMPLE WATER RUNNING PROGRAM

The following program has been developed by Canada's University of Waterloo coach, John Swarbrick (Swarbrick, 1996), and has been slightly modified for this issue of the *@-Letter*. The program runs for 16 weeks beginning in November and following through to March. This program uses a 3 + 1 microcycle (3 weeks hard + 1 week regeneration). At the University of Waterloo the greatest proportion of intensity work on the track takes place on Tuesdays with higher volume and lower intensity work on Thursdays. For this reason the pool building session takes place on Monday and the regeneration session is on Wednesday.

Explanation of abbreviations:

BDW: Building day workout; a hard, deep-water running day that replaces an on-land track workout.
RRS: Recovery and regeneration session used after hard track day.
WR: Water running.
H: Hard.
E: Easy.
R: Recovery.*
SR: Recovery between sets of exercise.*
FR: Full recovery.*
T: Approximate time to complete workout.

* All recovery can be done as either treading water, easy running in the water, or easy swimming in the lanes of the pool.

Off-season

Week One (total effort time: 65 minutes)

BDW: 4 x (3 min H + 3 min E) WR
SR = 5-8 min
3 x (30 sec H + 1 min E) WR
T: 40 min

RRS: 400 m kicking in swimming lanes done as: alternating 50 m H + 50 m relaxed kicking with a float board
5 x (45 sec H + 45 sec E) WR
SR = 3 min
2 x (45 sec extended striding + 45 sec R) WR
T: 25 min

Week Two (total effort time: 75 minutes)

BDW: 3 x (2 min H + 1 min E + 2 min H + 3 min E + 2 min H + 4 min E) WR
SR = 5 min easy jogging in water
3 x (30 sec H + 1 min E) WR
T: 60 min

RRS: 200 m kicking in swimming lanes with float board, alternating (50 m H + 50 m E)
5 x 1 min short fast strides WR, 30 sec R between efforts
T: 15 min

Week Three (total effort time: 80 minutes)
BDW: 4 x (3 min H + 30 sec E + 2 min H + 20 sec E) WR
SR = 3 min recovery jog
T: 40 min
RRS: 600 m kicking in swimming lanes done as: 100 m kick with float board + 100 m kicking without board
6 x (30 sec H + 1 min E) WR
6 x (60 sec medium pace + 30 sec E)
T: 35-40 min

Week Four (total effort time: 60 minutes)
BDW: 4 x (3 min H + 2 min E) WR
FR
2 x (5 min H + 3 min H + 1 min H) WR, 30 sec R between efforts
T: 30 min
RRS: 300 m kicking with a float board in swimming lanes done as: 3 x (50 m H + 50 m E)
SR = 3-4 min
8 x (15 sec all out + 30 sec E) WR
SR = 3-4 min
5 x (60 sec medium + 30 sec H + 60 sec E) WR
T: 30 min

Pre-season

Week Five (total effort time: 70 minutes)
BDW: 1 min H + 1 min E (WR)
2 min H + 2 min E (WR)
3 min H + 3 min E (WR)
4 min H + 1 min E (WR)
5 min H + 30 sec E (WR)
6 min steady into warmdown (WR)
T: 40 min
RRS: 450 m kicking in swimming lanes done as: 3 x (100 m hard + 50 m easy, on back)
8 x 15 sec H + 30 sec E (WR)
6 x 45 sec H + 60 sec E (WR)
4 x 90 sec steady WR with 3 x 10 sec bursts of speed
T: 40 min

Week Six (total effort time: 75 minutes)
BDW: 3 x (5 min steady + 1 min E + 3 min H) WR
SR = 3-4 min
T: 35 min

RRS: 600 m kicking with float board in swimming lanes done as:
3 x (100 m H on front + 100 m H on back)
10 x (20 sec H + 60 sec E) WR
SR = 2-3 min
8 x (2 min steady with 6 x 10 sec bursts) WR
T: 40-45 min

Week Seven (total effort time: 90 minutes)
BDW: 4 x (5 min steady + 1 min E + 3 min H) WR
SR = 2-4 min
T: 40 min
RRS: 600 m kicking in swimming lanes done as: 2 x (100 m slow + 100 m medium + 100 m fast)
SR = 3 min
12 x (20 sec H + 20 sec R) WR
SR = 2-4 min
10 x (30 sec H + 1:30 E) WR
T: 50 min

Week Eight (total effort time: 60 minutes)
BDW: 3 x (30 sec H + 30 sec E) WR
3 x (60 sec H + 60 sec E) WR
3 x (1:30 H + 1:30 sec E) WR
3 x (2 min H + 2 min E) WR
SR = 2-3 min
T: 32 min
RRS: 400 m kicking with float board in swimming lanes done as:
8 x (25 m H + 25 m E)
SR = 2-3 min
10 x (15 sec H + 60 sec E) WR
T: 25 min

Competition I

Week Nine (total effort time: 50 minutes)
BDW: 1 min H + 1 min E (WR)
2 min H + 2 min E (WR)
3 min H + 2 min E (WR)
4 min H + 1 min E (WR)
5 min H + 20 sec E (WR)
1 min steady into warmdown (WR)
T: 20 min
RRS: 400 m kicking with float board in swimming lanes done as:
4 x (4 x 25 m H + FR)
SR = 2-4 min
2 x (8 x 30 sec H + 60 sec E) WR
5 min water jog between sets
T: 30 min

Week Ten (total effort time: 70 minutes)
BDW: 3 x (6 min steady + 1 min E + 4 min H)
SR = 3 min
T: 40 min

RRS: 600 m kicking with float board in swimming lanes done as:
3 x (150 m H + 50 m E)
4 x (15 sec H + 60 sec E + 30 sec H + 60 sec E + 45 sec H + 60 sec E) WR
T: 30 min

Week Eleven (total effort time: 75 minutes)
BDW: 2 x (30 sec H + 3 min steady + 30 sec H)
SR = 2-3 min
3 x (1 min H + 1 min E + 1 min H + 30 sec E + 1 min H + 15 sec E + 1min H)
SR = 2-3 min
T: 40 min
RRS: 600 m kicking with float board done as: 3 x (100 m H + 100 m E)
SR = 3 min
5 x (15 sec H + 1 min E) WR
5 x (30 sec H + 30 sec E) WR
T: 35 min

Week Twelve (total effort time: 40-50 minutes)
BDW: 30 sec H + 30 sec E (WR)
1 min H + 1 min E (WR)
1:30 min H + 1:30 min E (WR)
3 x (30 min steady + 3 min easy) WR
T: 20 min
RRS: 500 m kicking with float board (150 H + 50 E)
4 x (15 sec H + 60 sec E + 30 sec H + 60 sec E + 45 sec H + 60 sec E) WR
T: 30 min

Competition II* *Week Thirteen*
BDW: 2 x (3 min H + 1 min E + 3 min H + 45 sec E + 3 min H + 30 sec E) WR
SR = 3-4 min

Week Fourteen
BDW: 3 x (3 min H + 6 min steady + 2 min H) WR

Week Fifteen
BDW: 4 x (1 min H + 2 min steady + 1 min H) WR
SR = 2-3 min
3 x (30 sec H + 6 min steady + 30 sec H)

Week Sixteen
BDW: 40 sec H + 40 sec E + 1 min H + 1 min E (WR)
2 min H + 2 min E + 3 min H + 3 min E (WR)

* In this unloading phase there is only one pool session per week.

General Theme

RECOVERY AND REGENERATION

1 Introduction

Athletes are fatigued after training, and the greater the fatigue, the greater the after-effects, such as low recovery rate, poor coordination, and decreased speed and power of muscle contractions. Strong emotional fatigue often accentuates normal physiological fatigue, especially following competitions, from which it takes longer to recover.

Coaches and training specialists should continually look for methods that allow athletes to overcome the limits of training and increase performance. One of the most effective methods is recovery techniques. Coaches must understand and actively enhance recovery so it becomes a significant training component.

Proper recovery

- accelerates the regeneration rate between training sessions,
- decreases fatigue,
- enhances supercompensation, and
- facilitates the use of heavy loads in training.

It can even decrease the number and frequency of injuries, because fatigue impairs coordination and concentration, leading to poor movement control.

Recovery techniques must become habitual and be synchronized with the biological adaptation to a training demand and the correct alternation of work with regeneration. Recovery should not follow only isolated training lessons and main competitions but must be daily concern. This way, athletes regenerate following the training session and prevent acute exhaustion and overtraining (cf. Bompa, 1999, p. 96).

2 The recovery curve

The dynamics of the recovery process are not linear but curved. The line drops dramatically by 70% during the first third and less drastically during the second and last third by 20% and 10% respectively. To move from the first third to the last third may take from several minutes to several months depending on which energy system is taxed and whether the athlete is recovering from short-term fatigue and exhaustion or long-term overtraining, which involves the neuroendocrine system.

Recovery of various biological parameters and substances occurs sequentially. First, heart rate and blood pressure return to normal 20 to 60 minutes following the work. Restoring glycogen takes 10 to 48 hours after aerobic work and 5 to 24 hours following anaerobic intermittent activity. Proteins take 12 to 24 hours, and fats, vitamins, and enzymes take more than 24 hours.

3 The three phases of recovery

Although recovery from extended exercise is a complex process, it can be broken down into three parts (cf. Burke, 1999, pp. 43-46).

- The first phase of recovery, known as the rapid phase, occurs in the first thirty minutes after exercise.
- This is followed by the intermediate phase, which lasts up to two hours.
- The longer phase of recovery occurs during the remaining twenty hours before the next exercise session.

3.1 The rapid phase

The rapid phase of recovery begins immediately after the training session, and lasts for approximately 30 minutes. During this time, the body's metabolic rate slows and begins to return to pre-exercise levels. The heart rate, respiratory rate, and body temperature start to return to their lower resting levels. Blood levels of certain hormones, such as cortisol or testosterone, which were elevated during exercise, begin to decrease. At the same time, the muscles start to replenish their stores of creatine phosphate and ATP, which were depleted to fuel activity. This is also the period during which the body removes excessive lactic acid that may have accumulated in the muscles.

The metabolic and physiological processes that occur during the rapid phase of recovery can be hastened by gentle exercise during the cool-down period. Exercising at 40-60% of maximum effort for 5-10 minutes helps to keep the blood circulating at an increased rate. This aids in the removal of lactic acid from the muscles, and rapidly transports it to the appropriate sites for conversion.

3.2 The intermediate phase

The intermediate phase of recovery continues in the 90 minutes to 2 hours after exercise. During this time, the body begins the process of restoring fluid volumes, called rehydration. This is also the most critical period for the replenishment of muscle glycogen, in which the hormone insulin plays a vital role. Insulin facilitates the transport of glucose from the blood into the muscle cells. It also stimulates glycogen synthase, an enzyme in the muscle cells that is responsible for converting glucose into glycogen for storage.

The intermediate phase is such a critical stage in the recovery process because muscle cells are most sensitive to insulin during this time. This means that when a sufficient source of carbohydrate is present, glycogen replenishment occurs at a faster rate. In fact, the speed of glycogen synthesis in the two hours following exercise is almost 2-3 times faster than normal.

In order to take full advantage of this increased insulin sensitivity, it is recommended to drink a carbohydrate-containing beverage such as a sports drink as soon after an event or training session as possible. If one does not consume a carbohydrate supplement during this period, one misses the period of maximum insulin sensitivity, and the rate of glycogen recovery will be significantly slowed. Thus, the longer an athlete waits to replenish his or her glycogen stores, the longer it will take him or her to recover.

3.3 The longer phase

The longer phase of recovery spans the 2-20 hours following a workout. Carbohydrate replenishment continues in this interval, although at a lesser rate than during the first two hours following exercise. It is recommended that one consumes 3-5 grams of carbohydrate per pound of one's body weight during the hours between workouts. Most of the carbohydrate intake during this time should come from complex carbohydrates (pasta, breads, and vegetables), which consist of long chains of glucose that must first be broken down during digestion. This breakdown ensures a slow, steady supply of glycogen.

A crucial element in the long-term recovery process is muscle repair. During heavy exercise, the membrane of muscle fibers, the connective tissue surrounding them, and the actin and myosin filaments of the muscles are damaged. Less strenuous exercise also damages muscles, but to a lesser degree. Therefore, whether one engages in a moderate activity, such as jogging, or a more strenuous exercise like weightlifting, sprinting, or high-intensity running, one's muscles require time and nutrients for repair.

The long-term phase of recovery is the period in which muscles are repaired and adapt to exercise, which increases strength and endurance. The question, then, concerns how much "damage" one must do in order for the muscles to become stronger. It is not necessary to exercise to the point of muscle soreness because one can go in small steps and get the same type of changes. In fact, research shows that in the case of extreme soreness and pain strength is reduced, sometimes by as much as 25%. And the more it hurts, the longer it takes to recover one's strength so that one can again exercise at one's peak capacity.

4 The causes of muscle soreness

In the past, lactic-acid buildup was considered to be the cause of prolonged muscle fatigue and discomfort. However, lactic acid is completely washed out of the muscles within the first 60 minutes after an exercise session. Since muscle soreness does not make itself known until 24-36 hours later, it's been necessary to look for other explanations (cf. Burke, 1999, pp. 37-41).

4.1 Mechanical damage

Current scientific research points to muscle damage as the primary cause of muscle soreness (cf. Noakes, 2003, pp. 500-504).

When an athlete strains his muscles, he produces localized damage such as microscopic tears to muscle fiber membranes and protein filaments. Over the 24 hours following strenuous exercise, the damaged muscles become swollen and sore. In addition, there is increased blood flow to the muscles, which causes the muscle tissue to swell. Muscle nerves perceive this abnormal state and send pain messages to the brain as soon as the athlete tries to move after overexertion. By moving sore muscles, the athlete increases circulation, which brings protein and other nutrients to muscles that need to be repaired. Moving stiff and sore muscles also helps to reduce swelling. This gradually begins to restore them to a normal state.

The biochemical marker creatine phosphokinase (CPK) is an excellent measure of muscle damage. CPK is an enzyme used in metabolism that is found mainly in the cells of skeletal and heart muscle. When skeletal muscle is damaged due to a muscle tear or from overuse, CPK begins to leak out of the muscles' cells and blood levels of CPK rise within the hour. Research suggests that the rise in CPK is proportionate to the amount of skeletal muscle damage.

Typical short-term treatments for sore muscles include stretching, massage, topical application of sports balms or creams, submersion in a hot tub, or a session in the sauna. Some athletes also turn to aspirin and anti-inflammatory medication to reduce pain and inflammation.

4.2 Free-radical damage

All of the body's cells are made up of atoms that, in turn, contain paired particles called electrons. When every electron in an atom is paired with another electron, the atom is said to be stable.

> A free radical is an atom or a group of atoms (a molecule) that is short one electron, and is considered to be highly unstable. In order to restabilize itself, the free radical will actively seek out and steal an electron from another part of the cell.

Free radicals are also known as oxidants because oxygen is usually the atom that loses an electron and then snatches other molecules' electrons. Therefore, free-radical damage is also known as oxidative stress.

Free radicals are continuously formed as a normal consequence of body processes, and are also caused by environmental factors such as air pollution and radiation.

> Exercise, too, has been associated with the formation of free radicals. Free radicals can damage muscle cell membranes and increase protein breakdown. They can also attack the walls of the muscle cells and mitocondria, and are at least partially to blame for muscle inflammation and soreness.

Vitamins and vitamin-like nutrients that can neutralize free radicals are called antioxidants. Antioxidants may be vital components in reducing post-exercise muscle soreness. Vitamins E and C are some of the better known antioxidants.

4.3 The cortisol response

Cortisol is a hormone that is released in response to all kinds of stress, including psychological, physical and emotional stresses. Exercise places physical stress on the body, which stimulates the release of cortisol from the adrenal glands attached to the top of each kidney.

The primary role of cortisol is to help mobilize energy for the body. It does this by attacking muscle tissues directly, and increasing the rate at which protein in the muscles is broken down.

In addition to this, cortisol impedes the entry of amino acids into muscle cells for protein synthesis, and instead helps to transport them to the liver to be used for energy. This is why individuals involved in strength training may experience a decrease in muscle mass if they do not take the necessary steps to reduce the release of cortisol and to rebuild muscle protein.

For a number of years, athletes have used anabolic (muscle-building) steroids to negate the effects of cortisol by helping the body to build itself back up. With steroid use, amino acids are taken up by the muscles at a higher rate to help repair some of the damage caused by cortisol when it extracts important nutrients for energy. However, the long-term use of anabolic steroids has been linked to the development of illnesses such as liver cancer and heart disease.

5 The time of using recovery techniques

For peak physiological and psychological regeneration, recovery techniques should be used at specific times before, during, and after training or competition. Time should be allowed for restorative measures.

When athletes take special recovery measures within 6 to 9 hours or sooner, they facilitate supercompensation and increase working capacity following work.

Ignoring adequate regeneration can have a negative influence on supercompensation by making it nonexistent or by delaying it (cf. Bompa, 1999, p. 99).

6 The choice of recovery techniques

The choice of recovery techniques depends on residual fatigue accumulated from past training sessions, which energy system has been taxed, and the time of day. For example, if training or competition concludes late in the evening, only techniques should be used that will not interfere with the athlete’s sleep. The next morning, techniques may be used that were impractical the night before (cf. Bompa, 1999, p. 99).

7 Kinotherapy (active rest) as a natural means of recovery

Unlike physiotherapeutic means of recovery (e.g. massage, heat therapy, cold therapy, contrast baths), natural recovery methods do not require any special devices or modalities. A widely used method of natural recovery is kinotherapy (active) rest.

Kinotherapy refers to rapidly eliminating waste products (lactic acid) during moderate aerobic exercise or stretching. Athletes can use stretching alone or with active rest.[2]

The intensity of the aerobic exercise during kinotherapy should not be higher than 60% of the athlete's maximum heart rate. Light, continuous jogging removes about 62% of the lactic acid during the first 10 minutes and an additional 26% between 10 and 20 minutes. It seems advantageous, therefore, to maintain an active recovery period for 10-20 minutes after strenuous exercise to produce an 88% reduction in lactic acid (cf. Bompa, 1999, p. 100).

8 Water running to speed recovery

An extremely beneficial means to speed recovery and also to maintain fitness during an injury is water running (sometimes called aqua or pool running). Water running involves the simulation of running technique in deep (deep-water running) or shallow water for a low- or no-impact run session (cf. Watson, 2003). In addition to reducing the pounding on injured joints, muscles or tissue, the pressure of the water against one's legs as one runs through it helps flush waste products from the muscles. Thus, water running is in fact a combination of active recovery and massage (cf. Henderson, 2003).

Since water running elicits the physiological responses necessary to promote a training effect as defined by the American College of Sports Medicine (40-85% VO_2max or 55-90% maximum heart rate), it also provides an effective means to continue training during rehabilitation. Water running may then be incorporated into a regular training program, providing a low-stress form of additional cardiovascular exercise (cf. Wilder & Brennan, 1993).

[2] Stretching will be dealt with in one of the next issues of the *@-Letter*.

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