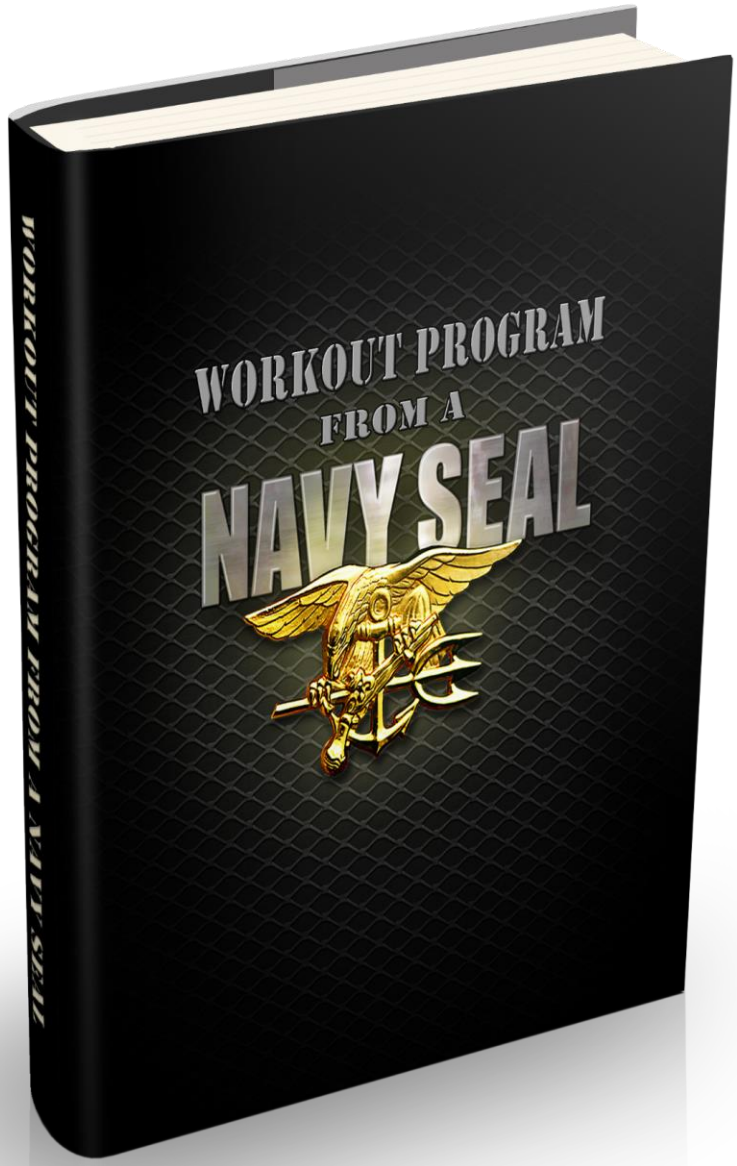
WORKOUT PROGRAM
FROM A
NAVY SEAL
WORKOUT PROGRAM FROM A NAVY SEAL

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Body Study

A Workout program is typically considered a set of characteristics that people gain through various physical efforts. In fact, physical fitness consists of a variety of measurable components, some of which are skill-related and others which are health-related.

Muscle Structure and Function

The three major types of muscle are:

- Cardiac muscle
- Skeletal muscle
- Smooth muscle

This discussion will be limited to skeletal muscles which, by converting chemical energy to mechanical energy, produce movement. We will present a description of the subtypes of skeletal muscles, including their characteristics and distribution. Although there may be many new subtypes of skeletal muscle fibers, generally skeletal muscle can be characterized into three basic types:

- Slow Twitch Oxidative (Type I)
- Fast Twitch Oxidative-Glycolytic (Type Ila)
- Fast Twitch Glycolytic (Type lib)

Type I Muscle Fibers

Type I muscle fibers are involved in endurance activities. These fibers, also called slow twitch fibers, are noted for their ability to produce energy in the presence of oxygen. Thus, they are primarily aerobic. The main fuel source for this fiber is fats (fatty acids), which

allow the muscle to work at a steady rate with noticeable resistance to fatigue. Their color is typically quite red, a result of the high content of “myoglobin”, an iron-containing protein that stores and delivers oxygen. Slow twitch fibers are not noted for their speed, their anaerobic capacity, or their ability to contract at a fast rate repeatedly, but rather their indefatigability and aerobic capacity.

Type II Muscle Fibers

Type II fibers can be categorized into at least two types: Type Ha and Type lib. These fibers are adapted for strength and power activities. The Type Ila fiber is a cross between a slow twitch and a fast twitch fiber in that it is both aerobic (oxidative) and anaerobic (glycolytic). Whereas, it is “faster” than the slow twitch fiber, it is not as well suited for endurance activities. Its color is also reddish, a result of the myoglobin content.

In contrast, the Type lib fiber is truly a fast twitch fiber, with very high contraction speeds. These fibers are almost exclusively anaerobic and have minimal capacity for aerobic production of energy. They rely primarily on glycogen within the muscle for energy and are therefore very susceptible to fatigue. Their color is pale, and some consider it "white” because it lacks myoglobin. Type lib fibers tend to accumulate lactate, which ultimately leads to rapid fatigue if the lactate is not removed.

It should be noted that each of the fiber types has different recruitment patterns, and typically the Type lib fiber is only recruited for use during maximal effort. The other fibers contract during light as well as moderate activity. Moreover, physical training can lead to changes in the characteristics of the fibers. Thus,

endurance training would lead to changes in the Type Ila fiber such that they take on more characteristics of the Type I, or slow twitch fiber.

Distribution of Fiber Types

The amount of Type I and Type II muscle fibers in an individual is genetically pre-determined, and all normal skeletal muscle contains all fiber types. However, the proportion or distribution of these fiber types within and across individuals differs. Moreover, within an individual, the distribution of fibers in various muscles can vary widely.

Physical training may transform muscle fiber type, and the metabolic capacity of both type I and type II muscle fibers can be modified by endurance and power training. It should be noted that performance depends not only on your fiber type composition, but also on the interplay between a variety of factors such as training, and diet, etc.

Principles of Physical Training

The goal of any training program is to improve performance. You are unique in terms of your excellent physical condition and your dedication to further enhancing your fitness. The four principles that apply to all physical training programs are discussed below.

Overload

According to this principle, exercise must be done at a higher level than usual to bring about various training adaptations. Once the body has adapted to the higher level of exercise it will function more

effectively and efficiently. The overload can be obtained by manipulating various combinations of exercise frequency, intensity, duration and type of exercise. Increasing intensity, duration and frequency can be helpful for running, cycling or swimming, and increasing resistance and repetitions can improve strength training.

Specificity of Training

This principle refers to the training-induced adaptations in metabolic and physiologic systems which are specific to the type of exercise. For example, running will increase physical fitness but it will not increase swimming performance and vice versa. Thus, it is important to train muscles involved in a specific type of exercise to realize greater performance benefits.

Individual Differences

Responses to a particular training program can vary from one individual to another. According to this principle, exercise programs should be individualized to meet the training requirements and physical capacity of each person.

Detraining

Regular exercise is necessary to maintain fitness. Beneficial effects of exercise are gradually lost or reversed after a few weeks off from training. This deconditioning or detraining effect will be discussed later in this chapter.

It is imperative that you develop all aspects of physical fitness: strength, speed, flexibility, and endurance. Therefore, it is important for you to consider your training in terms of the FITT principle.

FITT = Frequency, Intensity, Time &Type

All four aspects of the FITT principle must be included to achieve the most benefit from your training program. Number and intensity of workouts is important as is the time spent exercising and cross training. Information on how to determine your training intensity is provided next.

Determining Your Training Heart Rate

When reading the training methods presented in this chapter and throughout this guide, you will come across references to exercise intensity. Intensity is the rate at which exercise is performed. If you work out in a gym you may have used an exercise machine that monitors exercise intensity. A quick and easy method for measuring the intensity of your workout is by measuring your heart rate and checking to see if you are within your target training zone.

Measure your heart rate by taking your pulse at the carotid artery (neck) or the radial artery (wrist) for 15 seconds; multiply this value by four to get your heart rate in beats per minute. Compare this heart rate value to your target training intensity. If your heart rate is too low, increase the intensity of your workout. If it is too high, reduce the intensity slightly.

Your target training heart rate can be calculated as follows:

To maintain aerobic conditioning, exercise should be performed at a heart rate between 70% and 90% of your maximal heart rate (Max HR).

Remember, this is only an estimate of your maximal heart rate.

Depending on your particular "physiology" and physical conditioning, your Max HR could be higher than what you derive from this equation. However* this is the way it is routinely estimated.

Max HR in beats per minute = 220 - your age (years)

To calculate 70% and 90% of your Max HR, multiply Max HR by 0.70 and 0.90, respectively. This is your target training intensity zone or the range within which your heart rate should be while working out.

Determining Your Target Heart Rate

22 years old

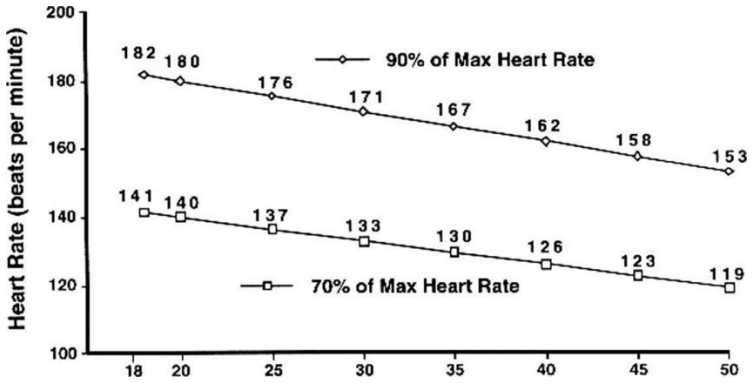
Max HR = 220 - 22 = 198 bpm

Lower Target HR = 0.7 X 198 = 139 bpm

Upper Target HR = 0.9 X 198 = 178 bpm

Calculate your target training heart rate zone using the formula provided above. It is important to note that maximal heart rates tend to be lower during swimming and arm exercises. For these activities you should subtract 13 from your maximal heart rate to before obtaining your training heart rate.

Target Training Heart Rate Zone



An Example for Determining Your Target Training Heart Rate for Swimming

A 22 year old man wants to swim at 70% of Max HR

Then his Max HR = 220 - 22 = 198 -13 = 185 bpm 70% of Max HR = 0.7 X 185 = 130 bpm

Energy Systems Used by Exercising Muscle

Before describing the methods used for physical training, it is important to understand the three systems that provide energy to the exercising muscle. All three systems are important. Depending on the activity, there may be a greater reliance on one system over the others.

ATP-CP System for Speed Work

Adenosine triphosphate (ATP) is the immediate source of energy within all cells of our body for activities such as sprinting. There are small stores of ATP within skeletal muscle, and these energy stores provide immediate energy to sustain physical activities for a short time. Once the ATP is used, it breaks down into adenosine diphosphate (ADP). For regeneration of ADP into ATP for more energy, creatine phosphate (CP) is needed. It is the CP that

regenerates the ATP. Without CP, ATP could provide energy for only a few seconds. With CP, the ATP-PC system can provide energy for about 30 seconds before other energy systems must take over. Thus, this ATP-CP system, sometimes referred to as the phosphate pool or reservoir, provides immediate anaerobic energy for muscle contraction.

ATP ► ADP + Phosphate + Energy

ADP + CP ► ATP + Creatine

Lactic Acid and ATP-CP System for Anaerobic Work

This is a transitional system. When all-out exercise continues beyond 30 seconds, the only way to continue providing ATP to the exercising muscle is by using sugar (glucose) in the muscle. Sugar in the muscle is obtained from glycogen, and the process of breaking down sugar for energy is called glycolysis.

However, in the process of generating ATP from glucose, lactic acid (also known as lactate) is formed. Normally there is a only a small amount of lactate in blood and muscle. When lactate begins to accumulate in muscle and then blood, you will begin to experience muscular fatigue, unless it is cleared by the body.

Lactate is cleared from the muscle if the intensity of the exercise is moderate. This happens because after a few minutes the aerobic or oxygen system, which supplies energy for sustained work, kicks in. If an all-out effort is sustained, fatigue is inevitable within three to five minutes.

Oxygen System for Aerobic Energy

The oxygen, or aerobic, system provides energy to support long-term steady state exercise, such as long distance running or swimming. Muscles can use both glucose and fatty acids for energy. These fuel sources can be taken from the circulating blood and from stores within the muscle. Glucose is stored as glycogen and fatty acids are stored as “triglycerides" in the muscle. When long duration activities arc performed at a slow pace more “fat” in the form of fatty acids is used for energy than muscle glycogen.

During many types of exercise, all three energy transfer systems arc used at various times. The amount that each system contributes to energy metabolism is related to the duration, intensity and type of activity. In general, high intensity, short duration exercises rely mainly on anaerobic energy.

Methods of Physical Training

Most people think of exercise as being either aerobic or anaerobic. However, in most types of exercise, a blend of both aerobic and anaerobic exercise is involved. For example, during a 1500 m run, energy is provided by anaerobic metabolism at the beginning and the end of the run whereas aerobic metabolism supports the middle or the steady state part of the run. Aerobic and anaerobic capacity can be improved by using appropriate physical training techniques.

Interval Training

Exercise bouts are alternated with rest or relief periods. Relief periods usually involve mild to light exercise. Generally, in swimming no exercise is performed during the relief periods. The duration, intensity, and number (repetitions) of exercise bouts and

the length and type of relief intervals are chosen to suit specific exercise performance requirements. Interval training allows you to exercise at a higher intensity than you could if you were exercising continuously. This type of training helps to develop the muscle ATP-PC energy system. Both aerobic and anaerobic metabolism can be improved by interval training.

Sprint Training

Sprint training helps develop speed and increase muscle strength. Individuals are required to sprint repeatedly at maximum speed while allowing for complete recovery between sprints. In general, 6 seconds are needed to go from a stationary position to maximum speed. For a runner this would mean running 55 to 60 meters to reach that maximum speed.

Interval Sprints

This method involves alternately sprinting for 45 to 50 meters and jogging for 55 to 60 meters while covering a distance of about 3 miles. Interval sprinting helps to develop aerobic capacity.

Acceleration Sprints

Acceleration sprint training develops speed and strength. Running speed is gradually increased from jogging to striding to sprinting, followed by a recovery walk. This sequence is repeated. Intervals may range from 50 to 100 meters each. For example: 50 meters jogging, 50 meters striding, 50 meters sprinting and 50 meters walking.

Fartlek or Speed Play

The work Fartlek means “speed play" in Swedish. It involves running at fast and slow speeds on both level and hilly courses. Unlike interval training, the fartlek form of training does not involve specific exercise and rest periods; you do it as desired. For example, you may say to your buddy: “I’ll race you to the next stop sign”, and you would both run as fast as you can to that point. You may run at a slower pace for a few minutes, and then run fast again for as long as you want. In other words, it is a speed workout without structure. As such, it is well suited to general conditioning and provides variety to workouts.

Continuous Exercise Training

This type of training is needed to build endurance for activities such as distance running and open ocean swimming. Exercise is performed with distance in mind and may be done at a slow or a fast pace. The aerobic system is the main energy source for this type of activity.

Repetition Running

This method is similar to interval training, but unlike interval training, the length of the intervals are longer and usually range from 0.5 to 2.0 miles. Recovery between intervals lasts until the heart rate is under 120 beats per minute, or within 60% of your estimated Max HR.

Conditioning and Deconditioning

Conditioning and deconditioning, also known as training and detraining, are responsible for gains and losses, respectively, in fitness levels. Whereas conditioning is a gradual process and may

take six or more weeks to see specific effects, deconditioning occurs relatively quickly.

Effects of deconditioning will be noticed within one to four weeks. Deconditioning reverses the positive metabolic, cardiac, respiratory and muscle enzyme effects that result from conditioning. Some major effects of deconditioning include:

♦ Decrease in maximal aerobic capacity - Heart rate for a given exercise workload is higher and the amount of blood pumped by the heart with each beat is reduced.

♦ More rapid build-up of lactic acid during exercise which leads to earlier fatigue.

♦ Reduction in levels of key muscle enzymes which regulate the muscles ability to generate energy from various sources.

♦ Reduced ability to store glycogen in muscle between workouts.

♦ Reduced breathing volume which will decrease the amount of oxygen being taken to the exercising muscle

♦ Decreased endurance capacity - time to fatigue is shortened.

♦ Decreased ability to dissipate body heat during exercise: the ability to exercise in adverse environments, such as in the heat, is reduced due to all factors mentioned above.

Retraining is necessary to reverse the performance reducing effects of deconditioning. However, deconditioning can be prevented or minimized by maintaining usual exercise intensity during endurance and strength workouts, when the number or length of

work outs is decreased. Aerobic capacity and decreased lactic acid accumulation during exercise can be maintained by training at least two to three times per week at your usual training intensity. Strength gains can be maintained by including one to two strength training workouts sessions per week. Specific training methods for maintaining fitness under deployed conditions and while overcoming an injury will be discussed in other chapters.

Active Recovery

This type of recovery means that you continue to exercise at. a low to moderate (30% to 50% of your maximal heart rate) intensity for several minutes after your regular workout. For example, walk for 5 to 10 minutes after completing a run.

Cardiorespiratory Conditioning

The American College of Sports Medicine (ACSM) and the Centers for Disease Control and Prevention recently formulated new guidelines for the American public with respect to exercise. The new recommendations state that

"Every US adult should accumulate 30 minutes or more of moderate intensity physical activity on most, preferably all, days of the week".

They defined moderate intensity physical activity as "activity performed at an intensity of 3 to 6 METS, or the equivalent of brisk walking at 3 to 4 m.p.h. for most healthy adults". Whereas the previous recommendations for the US population emphasized the importance of extended periods of strenuous exercise, these new guidelines state that short, intermittent bouts of moderate exercise

are important and sufficient for health benefits. The overall goal of these organizations is to promote cardiorespiratory conditioning, an important aspect of overall fitness, health, and disease prevention. In this chapter we will discuss:

- Basic concepts of cardiorespiratory conditioning
- How to estimate your maximal aerobic capacity
- Types of aerobic activities and basic workouts

The important point is that this form of conditioning improves health and work capacity by enhancing the circulation and overall functioning of the heart and lungs.

Basics Concepts of Cardiorespiratory Exercise

Cardiorespiratory conditioning consists of both aerobic exercise, which requires oxygen to sustain muscle activity, and anaerobic exercise, which does not use oxygen for the short bursts of highly intense activity. Most daily work and activities are aerobic in nature, and thus, improving the delivery of oxygen to the working skeletal muscle will improve work performance. Your ability to utilize oxygen for exercise depends on a variety of processes including:

♦ Functioning of your muscles of respiration or pulmonary ventilation

♦ Ability of oxygen to diffuse across lungs into your blood

♦ Ability of heart, to increase rate of beating and amount of blood pumped with each beat

♦ Ability of blood vessels in and surrounding skeletal muscle to regulate blood How

♦ Ability of contracting skeletal muscle to extract and use oxygen in blood

All of these factors are important in determining your ability to sustain a submaximal workload, and your maximal aerobic capacity. Two other factors which help determine maximal aerobic capacity are your percentage of specific muscle fiber types and your genetic makeup. Some persons are endowed with a high aerobic capacity, whereas others not. However, everyone can and will improve if a cardiorespiratory conditioning program is followed.

Terms Related to Conditioning

Many terms are used to define or describe exercise conditioning and work rate, also referred to as exercise intensity or work load. The two terms used throughout this chapter for describing how to gauge your work rate will be maximal oxygen uptake and energy expenditure as calories/hour, or kcal/ hr. Other terms to describe work rate and their interrelationships will be discussed at the end of this chapter.

Maximal Oxygen Uptake

The primary measure or predictors of one's capacity to sustain work performance is maximal oxygen uptake (V02max) or maximal aerobic (cardiorespiratory) capacity. V02max is measured in milliliters per minute (ml/min), Liters/min, or after adjusting for body weight in kilograms, as ml/ kg/min; a higher value indicates a higher level of cardiorespiratory fitness.

Your maximal aerobic capacity or oxygen uptake is the best indicator of how much work you can sustain without fatigue.

Typical V02max values range from 30 ml (of oxygen)/kg/min for an unfit person up to 80 ml/kg/min for an exceptionally fit, endurance athlete. If the unfit and highly fit persons both weighed 70 kg (155 lb) then their respective absolute maximal aerobic capacities would be 2.1 liters (of oxygen)/ min and 5.6 liters (of oxygen)/min.

Using 1 liter of oxygen/min is equivalent to expending 5 kcal/min

As such, the unfit person can only work at a rate of up to 10 kcal/min (2.1 L x 5) whereas the highly fit could work at up to 25 kcal/min (5.6 L x 5 kcal) if needed. If a specific task required 2 L/min, then this would amount to 10 kcal/min of energy. Resting energy expenditure requires less than one kcal/min, or about 0.200 to 0.250 L (of oxygenVmin. In order to account for different body sizes, resting energy expenditure for an individual is usually defined as:

3.5 ml of oxygen/kg body weight/minute.

Thus, for a 70 kg (155 lb) man, resting energy expenditure would be approximately 245 ml/min or 0.245 L/min (3.5 x 70). This is equivalent to expending around 1 to 1.25 kcal/min.

Anaerobic Power

How much strenuous work can you sustain without oxygen? Most people can do very little for more than a couple of minutes. It is very important to realize that most people cannot work for very long at even 90% of their maximal aerobic capacity. This is because

everyone has a threshold at which the balance between aerobic and anaerobic energy systems begins to favor the anaerobic; your muscles cannot extract enough oxygen to produce the required energy. This is called your anaerobic threshold; the turning point can be monitored by the accumulation of lactate in your blood.

Of course, your body will know when there is too much lactate, because once lactate goes above a certain value, it starts to accumulate and unless you decrease your work rate, you will become too tired to continue working.

This anaerobic threshold, or "break point" varies among individuals, but ranges between 60% and 100% of your V02max; Interval workouts stress the anaerobic energy systems and will increase your anaerobic threshold and power.

Interval and fartlek workouts for running and swimming are described in their respective chapters, and such workouts for other forms of exercise are described later in this chapter.

Determination of Work Rate

One common denominator across all types of cardiorespiratory conditioning programs is exercise intensity and work rate. The term exercise intensity typically refers to how hard you are working as a percent of your maximal aerobic capacity. For example, you could work at an intensity equivalent to 50% (easy), 70% (moderate), or 90% (strenuous) of your maximal aerobic capacity or maximal heart rate.

Factors Affecting the Training Response

The terms duration, frequency and intensity are commonly used when talking about training for fitness or health. All training programs, whether running, biking, swimming, or climbing, strive to vary in duration, frequency, and intensity so as to optimize conditioning and minimize injuries. Five major factors determine the extent of your maximal aerobic capacity and the magnitude of your response to training. These include:

- Initial level of aerobic fitness
- Duration of exercise
- Frequency of exercise
- Intensity of exercise
- Genetics/heredity

General principles apply to all types of physical activities. Take the following general principles and apply them to your individual program.

- The degree of aerobic training is closely tied to intensity and total work, not to frequency of training. However, a minimum of 3 days per week is recommended.

- A greater training improvement (up to a point) will be noted if you exercise above 85% of V02max or 90% of your maximal heart rate once a week or every other week: interval training.

- Aerobic capacity will improve if exercise increases your heart rate to at least 70% of your maximum heart rate.

♦ A lower exercise intensity can be offset by exercise of longer duration.

♦ Maximal heart rate for swimming and other upper body exercise is lower than maximal heart rate for leg or whole body exercise. Thus, training heart rate (THR) can be 13 to 15 bpm lower for swimming/upper body exercise than when running, biking, or other whole body exercises.

♦ A threshold duration per workout has not been identified to maximize aerobic capacity.

Active Recovery

Throughout this guide, we will continually stress the importance of warming up, cooling down, and stretching. These are integral parts of any workout, regardless of the activity. The cool down, or recovery period, is very important because it will determine how you feel several hours after your workout. There are two types of recovery: active and passive.

Passive recovery, in other words, just resting, was recommended many years ago, and is still recommended when you exercise below 50% of maximal capacity. Active recovery is now preferred for exercise exceeding 60% of maximal capacity to accelerate removal of lactate. This may help prevent muscle cramps, stiffness, and preserve performance during subsequent strenuous exercise.

Active recovery involves exercising at 30% to 50% of maximal capacity for 5 to 10 minutes after a strenuous workout. Blood lactate removal after strenuous exercise is accelerated by active recovery: mild aerobic exercise.

How to Estimate Your Maximal Aerobic Capacity

Exercise testing is often conducted for assessment of cardiorespiratory Fitness. Types of protocols currently used to assess cardiorespiratory fitness or aerobic capacity are incremental work rate tests, where the exercise work rate is increased by a uniform amount at predetermined time intervals, and constant work rate tests, where the subject works at a submaximal constant work rate for a specified time period.

Your heart rate at the specific work rates are used to estimate maximal oxygen uptake. Although the most accurate test is conducted on a treadmill, a bicycle will give a good estimate. If you have access to a stationary bicycle, you can test yourself by using the incremental test protocol described. Although it is best to use a heart rate monitor, you can manually take your pulse at various times during the test.

Bicycle Exercise Test Instructions

This test is an incremental submaximal test with four stages; each stage lasts two minutes. If desired, you can continue to increase the work rate and exercise for five to six stages. If you use a bike that monitors revolutions per min (RPM), your RPM must be maintained at (SO. This seems like a slow pace, since you would usually bike at 70 RPM, but in order to achieve the desired work rate, 60 RPM pace is critical. Whatever type of bike you use, you must check to determine how to regulate kcal/hr.

Test Procedures

Adjust height of seat and handle bars to fit you, then if available, hook up a heart rate monitor and then start pedaling at a comfortable workload. If the bicycle permits, key in your body weight. This will make the test more accurate. After a couple minutes of warm-up, begin to exercise at level 1 or around 450 kcal/hr (± 25 kcal/min); record heart rate after two minutes (end of stage one).

Increase the workload to level 2 or approximately 550 kcal/hr and continue for two more minutes. Remember that all stages are 2 minutes, so proceed to levels 3 (650 kcal/hr) and 4 (750 kcal/hr) at the appropriate time. The test should take no longer than 8 minutes, after warming-up. Record your heart rate at the end of each stage

DO NOT STOP Pedaling While Recording Your Heart Rate.

Types of Aerobic Activities and Basic Workouts

Outdoor Activities

Aerobic activities, other than running and swimming, are briefly described below. More extensive discussions are provided in the section on indoor activities, since equipment used indoors typically has information about work rate and intensity.

Bicycling

Bicycle riding, or biking, is an excellent activity for improving overall cardiorespiratory fitness. Importantly, indoor bicycle ergometers have been used for many years to study the responses of the body to exercise. The work rate you maintain while biking varies

according to the terrain and your motivation. As such, biking outside offers many challenges.

It is also a very efficient means of locomotion: the energy cost of biking is only 20% of walking, but you can travel almost five times faster on a bicycle. The quadriceps muscle in the front part of the thigh is the primary muscle for high rates of power output, and seat height can markedly affect overall muscle involvement. Although pedaling rates vary from 40 to 100 RPM, a rate of 70 appears to be the most comfortable.

A high pedaling rate offers advantages in terms of a high power output.

All in all, biking is a great alternative to running, and should be considered as a suitable activity for maintaining fitness. Biking complements other activities and is often used in rehabilitation from other musculoskeletal injuries. More details with respect to biking will be provided under the section on stationary cycles.

Cross-Country Skiing

Although cross country skiing is discussed in detail under winter warfare below, it should be noted that this is an excellent method of training for cardiorespiratory fitness. It engages almost all of the major muscle groups and thus, the overall energy expenditure may be as high as or higher than when moving the body over the same distance on foot. Importantly, the intensity of the effort varies greatly as a function of the terrain: climbing uphill requires tremendous effort whereas going downhill represents a light load. High caliber cross-country skiers have some of the highest maximal

oxygen uptakes ever recorded. However, the appropriate equipment and environment are necessary for cross-country skiing.

Jumping Rope

Jumping rope is a great way to maintain fitness on board a ship or in confined spaces. It can provide a high intensity, cardiorespiratory workout if done long enough and fast enough. If the pace is fast, it is equivalent to running in terms of energy expenditure.

Jumping rope does not have to be boring, especially if you use different types of jumps.

Different Types of Jumps for Jumping Rope

With both feet together, shift weight from right to left with each jump.

Jump to the left while lifting left knee, then switch.

Start with right foot forward and left foot back, then switch each jump landing on both feet at same time.

Tap right toe on the floor, then jump from your left foot to your right; at the same time lifting left knee as high as possible. Switch legs.

Twirl the rope around twice between each jump.

Jump two times with feet together, then do a jumping jack every third time.

In terms of gear, many different types of rope are available, and rope jumping can be limited by the quality of the rope. Most experts

recommend lightweight leather ropes. Believe it or not, many books have been written about jumping rope, with basic to advanced skills, drills and moves. Overall, jumping rope is a great activity, especially if you are in a confined environment

Stationary Exercise Alternatives

Rowing Ergometer

There are many types of rowing machines on the market, and each has distinct advantages and disadvantages. The best rowing machine is one with variable resistance and the ability to regulate rowing rate. Most provide feedback on either watts or calories per hour, as well as meters covered.

Proper technique is critical so as not harm your lower back. If proper technique is maintained, cardiorespiratory conditioning can easily be achieved. In fact, both the upper and lower body are exercised, and it promotes flexibility by emphasizing maximum joint range of motion, so it is a total body workout. It is also impact-free so it is a great alternative to running! Some key points to remember are:

- The motion of the entire stroke should be fluid.
- A stroke rate between 24 and 30 per minute should be the goal.
- Your grip should be loose and comfortable with wrists level.
- The rule of thumb should be a longer not a harder workout.

How do you know if the workout is hard or light? Your body is the best judge, but knowing the kcal/hr will also help. A pace of 500 meters/4 minutes would be a light workout whereas a pace of 500/2 minutes would be strenuous. These paces equate to 385 and 970 kcal/hour for a 70 kg man.

Bicycle Ergometers

Cycle ergometers have been around a long time, and are still the mainstay in exercise/fitness testing. Monitors on the bicycles available today typically display kcal per hour.

Treadmills

Despite the fact that it is much nicer to run outside than inside, the treadmill is an extremely efficient way to maintain and/or improve cardiorespiratory conditioning. Unlike the cycle and rowing ergometer, jogging or running on a treadmill is weight dependent: the energy expended is determined by your body weight. In addition, it is an impact sport and should not be the only form of conditioning, so joints are protected and injuries minimized. However, if you are on a ship or in another type of confined space, a treadmill could maintain your fitness!

What kind of workouts should you do on a treadmill? Three days per week is more than enough, if you do other types of exercise on off days. On a treadmill, you can mix up your pace and/or change the resistance by changing the incline. The incline and speed will determine the intensity of the workout. Remember, a strenuous workout is over 750 kcal/hr, and a moderate workout would be 450 to 600 kcal/hr.

Ski Machines

The simulated skiing machine provides an excellent mode of exercise for whole body conditioning. It uses both the upper and lower body, and offers a range of settings so your workout can be light, moderate, vigorous or exhausting. Maintaining a comfortable rhythm is most important during a moderate workout, and is essential for progressing to a strenuous workout. Importantly, unlike running outside or on a treadmill, minimal stress is placed on the joints.

Most models have various settings for modulating leg resistance, and typically the resistance ranges from four to 32 lbs. Once you have determined your desired resistance the intensity of your workout will be determined by your average speed. Numerous tables are available which allow you to determine the number of calories expended per minute at various resistance settings and speeds. However, they are far too detailed to include here.

Some indoor skiing machines also have multiple settings for arm resistance, and adjustments to these settings should be made to ensure a moderate to vigorous workout. However, kcal/hr expenditure for arm settings becomes quite complicated and will not be presented here. All in all, ski machines provide great exercise.

Stair Steppers

Stair steppers provide an excellent alternative to running, biking, and other forms of aerobic exercise. Although stair-stepping is a weight-bearing exercise, the impact is much less than with running.

However, to get the full effect, instructions must be followed. Most people hang on to the handles and this diminishes the conditioning effect. An equally good workout could be gained by actually climbing real stairs for the same period of time; many people climb stairs without holding the handles, and thus carry their full weight up the steps. By hanging on, you allow your arms to support a portion of your body weight and the energy demands are less.

Most stair steppers have a variety of computerized, pre-designed programs to meet the needs of devoted users. There are interval training programs, climbing programs, manual programs, and many other creative exercise programs to vary the intensity of the exercise.

Although each manufacturer has its own energy cost equations, the way to determine work intensity is to determine the number of steps per minute; one step is typically 8 inches of vertical climb. A low intensity exercise would be a step rate of less than 35 steps/minute, whereas a high intensity workout would require a step rate in excess of 95. This is not an easy exercise routine.

Climbers

Workouts on a climber will build upper body strength and provide excellent cardiovascular conditioning. Different types of climbers are available, and each has specific characteristics. Regardless of which variety is used, climbers have common features: weight dependent exercise that conditions primarily the upper body.

Energy expenditure on a climber depends on your speed of climbing and your body weight. Some authorities would say that climbing

results in a greater energy expenditure than most other activities, but this depends on your strength and how hard you work.

Basic Workouts

The most important issue with respect to workouts is recovery. Rost is an exceedingly important factor in recovery from strenuous workouts, so back-to-back high intensity workouts are not encouraged. Experts recommend a hard day followed by an easy day, and at least one day of rest over a seven day period. This can be an excellent plan, but you should also let your body be your guide. Some days when you go to workout and feel great, this day can and should be a hard workout day. On other days when it is an effort to even get your workout clothes on, this should either be a rest day or an easy day.

Easy days could be a run, bike, or swim at a very comfortable pace for 60 minutes or more, an easy short workout, or a short hump with a light load. A hard day may be intervals, fartleks, a fast pace for a specified period of time, a long hump with a heavy load, or a competition among team members. The key is to make it fun, challenging, and interesting.

Other Terms for Work Rate

Other terms are frequently used to describe exercise intensity and work rate. These include:

- Work
- Power

- METS
- Watts

If these terms and concepts are learned, they will apply to almost all exercise equipment and conditioning programs. The terms work and power arc often used incorrectly. Because these terms can be expressed in a variety of ways, it is useful to understand or at least be familiar with the basic units of measurement.

Work and Power

Work = Force x Distance and is measured in kcal Power = Rate of Doing Work and is measured in watts

METs and Watts

The term MET, which was used in the national recommendations for exercise, is often used to estimate energy expenditure and work rate.

A MET is defined as a multiple of resting metabolic rate or energy expenditure.

One MET is between 0.200 to 0.250 liters (of oxygen)/min, or approximately one kcal/min, depending on the weight and body type of the person. Two METS would be two times resting metabolic rate or approximately 0.5 liters (2 X 0.200 to 0.250) of oxygen/min, or 2 kcal/min. Likewise, 3 METS would be 0.75 liters (3 X 0.200 to 0.250) of oxygen/min, or around 3 kcal/min.

Watts, as stated above, are units used to quantify the rate of doing work, or work/time. Most new exorcise equipment express work

rate in terms of watts, although many use METS instead of or as well as watts.

Running for Fitness

Running is a fundamental part of your physical training program and provides an excellent aerobic workout. Moreover, it is not expensive; most of the cost of running involves buying a pair of "good" running shoes. If you train intelligently and have the right gear, you can continue to enjoy the fitness and general sense of well-being that accompanies running while avoiding running injuries.

In this chapter, basic information is provided for maintaining a sound, middle distance running (20 to 40 miles/week) program; this is adequate for running 10K and half marathon races. Some of you may consider running a marathon in the future; at such a time you may want to get training tips from experienced marathoners, trainers at a running club or running magazines.

Running Gear

Running Shoes

A good pair of running shoes will provide shock absorption, cushioning, motion control and durability, and ultimately help prevent injuries. Under no circumstance should you buy shoes if they do not fit correctly. Running magazines usually have a yearly review of various running shoes, newest models of shoes and the type of runner the shoes are most suited to.

You can also obtain current information from "Running Sites/Pages" on the worldwide web. It is wise to try on several different shoes at

a sporting goods store to determine which one might be best for you. This is also important if you are planning to buy shoes from a catalog.

Pronation

It is important to understand this term because the type of running shoe you buy depends on whether you are a normal, over-, or under-pronator. While running, the outside of the heel strikes the ground first. Next, the foot rotates inward and downwards: this process is called pronation. Everyone pronates to some degree and pronation helps the foot absorb the shock of impact.

However, some runners over-pronate: their feet roll too far inward. Put your running shoes together and look at their heels/backs; if they lean inward, you are probably over-pronating. Another way to check pronation is to have a friend run behind you and have them watch the back of your heel as it makes contact with the ground: the greater the inward roll of your heel, the more you pronate.

Excessive pronation can lead to injuries of the lower leg and knee.

Other runners under-pronate or their feet do not have enough inward roll after striking the surface. Such individuals are considered to have “rigid” feet or feet that absorb shock poorly. Shoes are available to correct for either under or over-pronation.

Shoe Terminology

When buying running shoes, it is helpful to be familiar with some common terms.

Some General Terms

♦ Outsole is the material on the bottom of the shoe that comes in direct contract with the running surface.

♦ Midsole is the layer of cushioning that is placed between the upper and outsoles.

♦ Lateral is the outer-edge of the shoe.

♦ Medial is the inner or arch side of the shoe.

♦ Upper is the part of the sole that is above the midsole.

♦ Achilles notch is the U or V-shaped cut at the top of the heel collar which prevents irritation of the achilles tendon.

♦ Heel counter is a firm cup usually made of plastic that is encased in the upper and surrounds the heel to control excessive rear foot motion.

♦ External heel counter is a rigid plastic collar that wraps around the heel of the shoe to provide support and control excess pronation.

♦ Motion control designs or devices control the inward rolling or pronation of the foot. Some amount of pronation is normal: corrective measures are necessary only if there is excessive rolling or under-pronation.

Terms Related to Cushioning

♦ Cushioning is provided by midsoles and is needed for shock absorption.

♦ Cantilever is a concave outsole design in which the outer edges flare out during foot strike to provide better shock absorption.

♦ EVA is a foam-like material which is used in midsoles to provide cushioning.

♦ Polyurethane (PU) is a synthetic rubber that is used with EVA in midsoles. It is more durable than EVA but provides less cushioning. PU is used in the rear foot for firmness and EVA in the forefoot for flexibility and lightness in many shoe models.

♦ Metatarsal pad is a soft wedge of EVA that is placed under the ball of the foot to increase cushioning and shock absorption for runners who are fore-foot strikers.

Terms Related to Shape

♦ Last is a foot shaped piece of wood, plastic or metal which is used as a frame for building a shoe. Lasts can be straight or curved.

♦ Straight-lasted shoes are relatively straight shaped on the inner or medial side and provide support and stability and are recommended for runners who over-pronate.

♦ Curve-lasted shoes are shaped to curve inwards. This shape allows greater foot motion and such shoes can be worn by runners with normal pronation and arches.

Board lasting increases stability and is good for orthotics. A board-lasted shoe is made by gluing the upper to fiber board before it is attached to the midsole.

Slip lasting is the most flexible shoe construction wherein the shoe upper is stitched together like a moccasin before it is glued to the midsole.

Combination lasting as the term suggests is partly board and partly slip lasting. Such shoes are board lasted in the rear foot for stability and slip lasted in the fore-foot for greater flexibility. If you removed the sockliner you would see stitching in front and a fiber-board in the rear foot.

Pointers for Buying Running Shoes

- Maximum emphasis on shock-absorbing characteristics.
- Know your foot type.
- Look for shoes that come in widths.

Do you have normal arches, high arches or are you flat footed? You can assess your foot type by what is known as the "wet test": simply wet your feet and briefly stand on a piece of paper or on a dark, bare floor; look at the imprint left by your feet.

- Know whether you over- or under-pronate.

If you over-pronate you need shoes that provide stability, whereas, if you under-pronate you need shoes that provide shock absorption and cushioning.

- Know if you are prone to running injuries.

See a sports medicine doctor if you are predisposed to training/overuse injuries to determine if your injuries are related to

biomechanics. Biomechanical conditions, such as being an over- or under-pronator, or having one leg shorter than the other, often result in running injuries. In some cases, you may benefit from using orthotics (see section on orthotics) in your running shoes. Also, take your running shoes with you when you go to see your doctor.

- Try on shoes towards the end of the day.

Feet are smallest first thing in the morning and swell slightly as the day progresses. Also, wear running or sports socks while trying on shoes since they are generally thicker than regular socks. Walk around the store in the shoes to check the fit, cushioning and stability of the shoe. If you use orthotics, lifts or other inserts, bring them with you when you try on shoes.

- Do not buy shoes based on their brand name.

Buy shoes that suit your biomechanical needs and work for your foot- type, not shoes that a friend highly recommended or shoes you have seen a “good" runner wear. Consider going to a specialty shoe store where a knowledgeable salesperson can evaluate your running style and biomechanical needs, and recommend a shoe.

- Replace worn out shoes in a timely manner.

Wearing worn out shoes can eventually lead to injuries and cause knee or hip pain. It is a good idea to replace running shoes every 400 to 500 miles, or sooner if your shoes wear down quickly. One way to keep track of your running mileage is to establish a running log. A running log will not only help in keeping track of your running distance, but it will also help in tracking factors such as sudden increases in mileage or the onset of injury.

Motion control or stability shoes

Orthotics

Individuals with biomechanical conditions that result in pain and injury may benefit from using orthotics in their running shoes. Orthotics are shoe inserts that are customized to an individual's biomechanics and foot type to provide good foot support and motion control. First, a plaster mold of the foot is made and then inserts are developed to correct the biomechanical problem(s).

These inserts are usually made of cork soles covered by flexible leather or hard plastic. Orthotics should be gradually broken in; first wear them while walking and then progress to running. If not properly fitted, orthotics may worsen the problem. A podiatrist or sports medicine specialist is required to have them custom-made.

Sometimes low cost, over-the-counter, commercial orthotic inserts can work as well as customized inserts. For example, if the amount of pronation is not too much, over-the-counter inserts may correct the problem. Commercial inserts are sold by shoe size. If you find that the pain lessens, but does not go away or that the pain returns when you increase your mileage, you may need custom-made orthotics.

Cleats for Cold Weather Running

By putting on rubber cleats over a pair of running shoes you will be able to run outdoors under icy conditions. Personnel in the Arctic Warrior Brigade in Alaska use cleats when training in frigid weather. To obtain information about ordering these cleats, call Ft. Wainright (DSN 317-353-6048).

Clothes

Unlike many sports, running is not seasonal and with the right clothes, it is possible to continue to train outdoors on very hot or very cold days. When weather conditions are extreme, as in ice storms, blizzards or a major heat wave, outdoor training can be substituted with running on a treadmill in the gym. Thus, running clothes can range from a simple pair of running shorts and a singlet to running tights and gortex jackets, depending on environmental temperatures.

Cold weather running requires dressing in layers. Always keep your head and extremities warm in cold weather. Experience will teach you what to wear when running in the cold. If you wear too much, you may get hot after warming up, i.e., within the first mile or so.

Running socks tend to cost a bit more, but they are thicker and provide more cushioning than average sports socks. In most cases, sports socks are recommended as they provide adequate cushioning.

Other Gear Items

Heart Rate Monitors

You may have seen these advertised in running and fitness magazines. Some athletes use these for monitoring their training intensities. Such monitors consist of a wrist watch and a chest strap: the chest strap has an electrode which picks up your heart beat and transmits it to the watch which in turn displays your heart rate in beats per minute. If you know your target training zone you can

check and maintain your heart rate within that zone. Heart rate monitors are not a training necessity and can be expensive.

Reflectors

Putting reflectors on your shoes and running clothes is a great idea if you routinely run late in the evening, at night, or very early in the morning when visibility is particularly poor. This is especially important in urban areas where motorists may not be paying particular attention to runners. Note that you should also run against the traffic.

Fluid Containers that Strap onto Belts

As you already know, it is very important to maintain fluid balance and prevent dehydration. Thus, if your long runs include running for more than 90 minutes, especially in hot weather, it is advisable to strap on a fluid container and drink fluid (8 02.) at 30 minute intervals. If your running route provides access to water fountains then you need not carry your own fluid supply.

Headphones

Running with headphones can really help during long runs. However, it is not advisable to wear headphones and run on city streets as it may reduce your awareness of your surroundings. Running with headphones on base may be prohibited.

Running Surfaces

The ideal running surface is flat, firm, smooth and provides some shock absorption.

Other running surfaces include treadmills and water. Treadmills are very popular at fitness centers and may also be available to you when deployed aboard a ship. Most treadmills are state of the art in terms of cushioning and you can control the speed and intensity of your work out. Perhaps the biggest problem when working out on a treadmill is the boredom that is often associated with the monotony of the unchanging environment and the consistent pace. A portable cassette player or radio may be helpful, particularly during longer runs.

Deep water or aqua running is mainly used for rehabilitating injured athletes as it takes the pressure off of injured muscles and joints while providing cardiovascular benefits similar to those obtained with running on surface. This type of running is becoming popular at various swim centers.

Warm-Up

A warm-up to lengthen short, tight muscles before running is crucial for preventing injuries that may result if muscles are “cold”. A longer muscle is less likely to get injured than a short, tight muscle because it can exert more force with less effort than a short muscle. Another benefit of warming up is that it protects tendons. Warm up by slow jogging or walking for five to 10 minutes before you run. After you warm up you need to stretch your hamstrings, quadriceps, hip flexors, groin, calves, achilles, and the iliotibial band.

Cool-Down and Stretching

After completing your run, walk for a few minutes to cool-down. It is not a good idea to sprint at the end of your run and then come to a

complete stop; this practice may result in an injury. Cooling down helps to shift the blood flow from the muscles to the heart and other vital organs. A cool down lets your heart rate slow down and your body gradually return to its pre¬exercise physiological state. Cooling down properly and stretching after your run will go a long way towards preventing injuries.

Running Gait or Form

Different runners may have different running styles. Running is a function of footstrike, forward stride, body angle, and arm drive. The key is:

Run naturally and remain relaxed.

Footstrike

For most runners, other than sprinters or very fast runners, the heel- ball footstrike method works well: (1) the outside of the heel strikes the surface; (2) the foot rolls inwards to the ball of the foot while the knee is slightly bent; and (3) the foot lifts off from propulsion provided by the big toe. This method provides good shock absorption.

Forward Stride

The point of foot contact should occur in line with the knee which should be slightly flexed. As you improve and get faster, the length and frequency of your strides will increase and you will begin lifting your knees higher. Do not overstride such that your foot hits the ground ahead of the knee flex (i.e. leg should not be straight at point of impact). Overstriding is hard on the knees, back and the hips and

can cause injuries. Short, choppy strides, which usually result from tight or inflexible muscles, require more energy and are inefficient. Run with a relaxed stride and do not exaggerate the knee-lift or back kick.

Body Angle

Keep your back as straight as naturally possible, your head up and look ahead. Of course, depending on the terrain you may have to look down to avoid tripping or landing in a hole or rut. Lean forward only when going uphill or sprinting as this motion will put stress on leg muscles and may cause back pain and shin splints. Leaning back is not recommended as this puts tremendous pressure on the back and legs and has a "braking effect". The key is to run "tall" and remain relaxed; allow your shoulders to hang in a relaxed manner and let your arms drop from time to time.

Arm Drive

While running relax your shoulders, elbows, wrists and fists and occasionally let your arms hang down at your sides and loosely shake them out. Whereas vigorous pumping of the arms helps sprinters, it is unnecessary during distance running.

Building Your Mileage

Increasing mileage too quickly can cause training injuries. Your running mileage should be gradually increased and not by more than 10% to 20% from one week to the next. For example, if you can comfortably run four miles, increase your distance by a mile and maintain this new mileage for at least one to two weeks or until this

distance is consistently easy for you. Also, remember consistency is more important than speed.

A good rule of thumb: increase your mileage by no more than 20% a week.

When you can continuously run for 40 minutes, begin thinking about your running mileage or distance. Most of you, unless coming back from an injury or returning from a deployment, are already running 30 to 40 minutes as part of your fitness routine. However, if you have been unable to run for some time due to reasons mentioned above or other reasons, start out slowly; this will prevent you from getting injured and benefit you in the long run.

Running Frequency

Run at least three to four times per week or every other day. It is a good idea to build in one or two rest days in your weekly running schedule. These rest days do not necessarily mean no exercise, but rather an alternate type of exercise, such as biking or swimming. This allows your "running muscles" time for rest and recovery, and helps prevent overuse training injuries.

Running Speed and Intensity

When running for exercise and not competition, you should run at an even pace that allows you to talk comfortably. If you run too fast and get- breathless, you may not be able to go the distance. Also, speed work tends to tighten muscles and must be properly stretched afterwards. Failure to stretch may lead to an injury. One way to estimate your training intensity is to check your heart rate and see if it falls within your target training zone. As previously

mentioned, speed is not as important as being able to go the distance consistently.

Do not increase speed and distance simultaneously.

Increasing both at the same time may cause an injury. Hold one constant while you gradually increase the other. After you have been running 30 minutes continuously 3 - 5 times per week, you can begin increasing your running distance. Running 20 to 30 miles per week is a good training distance for an intermediate runner. If you would like to further increase your weekly mileage, remember to increase it by no more than 20% per week.

Another way to vary your workout is to have one long slow run and one fast run per week. Remember if you feel over tired, cut back your mileage or take a day off from running. With a running base of 40 miles per week you can easily run a half marathon.

Training for a Marathon

If you have been running 35 to 40 miles per week for 1 to 2 months, you have a good endurance base for running a marathon after 3 additional months (12 weeks) of training. To run a marathon, you must complete some long training runs in the weeks leading up to the marathon. The week that you run the marathon, however, should include only a few short runs. Your goal for your first marathon should be to complete it.

Other Points to Consider

♦ Make sure you eat enough carbohydrates and are well hydrated before the marathon.

- Start out slowly and pace yourself.
- Walk for a while if you get cramps or feel fatigued.
- Consider the environmental temperature; if it is a hot and humid day, it is especially important to pay attention to your fluid and electrolyte needs.
- After you finish, stretch and walk around. Take a hot bath.
- Slowly return to running.

Interval Training

Various interval training techniques can be used for building speed. Ideally, speed work would be done on a measured track. Two important points are:

- Rest periods between reps for intervals to train the anaerobic energy systems should be equal or slightly less than time to cover distance (quarter mile: 60 seconds; rest: 60 seconds)
- Rest periods to train aerobic system should be less than one-ha If time to cover distance (half-mile: 2:50; rest: 60 seconds)

Sample Sprint and Distance Running Interval Workouts

Sprint

One mile warm-up, slow pace 10 minutes lower body stretching Quarter mile sprint w/ 60 to 90 second jogs: Repeat five times Half mile sprints/ 2 to 3 minutes jogs: Repeat three times One mile cool-down, easy pace Whole body stretching

Distance

One mile warm-up, slow pace 10 minutes lower body stretching One mile sprints/1 to 2 minute jogs: Repeat four times Two mile cool-down, easy pace Whole body stretching

These are not the only interval workouts, so you may modify them to suit your requirements. For example, you could do pyramids: you would start with a quarter mile, followed by a half mile, 3/4 mile, and mile, then go back down in reverse. Between each speed set, it is best to jog one quarter to one half the distance to accelerate recovery.

Interval workouts are a great way to improve performance.

Varying Your Workouts

It is good idea to vary your daily running mileage so you have some "light" days in between heavy training. Avoid running long distances on two consecutive days, unless you are training for a marathon, to give your body time to recover. Listen to your body and pace yourself accordingly.

Most importantly, it is good to cross-train.

Consider biking, swimming, stair-climbing or other activities that will provide a good aerobic workout while mainly using muscles other than those used during running. A major benefit of cross training is that it prevents the onset of over-use injuries while maintaining fitness. Strength training, especially upper body strength workouts, have become an important part of a “runner’s”

overall workout. It is recommended that you strength train two to three times a week.

Swimming for Fitness

Swimming is an excellent exercise for overall fitness; aerobic endurance, power, strength, and flexibility are all enhanced by swim training. It is generally gentle on the joints and provides excellent cross training for running and other gravity-intensive forms of exercise by providing load-bearing joint rest.

However, training must be specific for the anticipated operational environment, including cold water acclimatization. This section will give you the tools to improve your swimming skills.

This section includes information on competitive swimming strokes and pool training. Open water training is essential as a part of a comprehensive training program under the general principle of “specificity of training". Surf and high sea state swimming provides specific training for potential operational situations by increasing your sense of timing and confidence.

Swim training should focus primarily on open water swims with fins.

Swim training is best accomplished with others for a variety of safety reasons. There should always be a guard or buddy available to you, even if you swim in a pool. You certainly should not train alone in open water.

Open Water Gear

In the pure sense the only gear required is a set of trunks. Look at the gear list for the UDT swimmers at Omaha Beach in 1944. It did not even include fins and masks. However, today there are some significant gear issues.

Goggles are necessary for any real swim training. Operational and open water swimming requires more gear. There are specific training aids that help develop strength and technique in pool training. Swimming is still an inexpensive sport with respect to gear; a complete set of the most expensive training gear for pool training will not cost over $100.

Wet Suits

Open water swimming may require thermal protection for safety. Males in particular may be susceptible to hypothermia and the first symptom in an open water swimmer may be unconsciousness from cardiac arrhythmia. Thermal protection in swimmers means a wet suit worn over an anti-chafe shirt.

Wet suits designed for open water swimming are generally of a Farmer John design with the arms free for stroking. In all but the coldest water, a 1/8* wet suit is best for surface swimming. Unlike diving, there is no need to factor in the loss of insulation due to compression of the neoprene with depth.

Anti-chafing shirts are generally made of nylon without elastic properties. Worn under the wet suit, the nylon shirt allows arm strokes and head rotation without getting chafing from the wet suit. If you don't use antichafe shirts, then this would not matter.

Hood, Gloves and Booties

♦ Good open water swimming hoods allow the head to be turned with minimal chafing. Thermal protection is not as good with the neck exposed. A good hood preserves a great deal of the swimmer's heat.

♦ Gloves may have webbed fingers to allow sidestroke pulling to be more efficient. They work great for freestyle, too. Neoprene web gloves are popular and work like paddles.

♦ Thin 1/8” booties without soles maximize the power delivered by the swimmer's legs to the fins.

Fins and Fin Selection

There are three factors to keep in mind when you are selecting a fin; the specific design characteristics of the Fin, the physical attributes particular to your body, and operational constraints. Fins, by increasing the surface area of the foot, serve to magnify the thrust delivered by the legs. Kicking with fins involves a forward stroke and a backward stroke.

♦ SDV operations require an operator to sit with fins on for a long period of time. The operator may require thermal protection and he may have a flexible ankle. Space is limited, so a shorter fin is necessary. For this situation, the operator should select a short, wide fin with a strap that can be adjusted for varying amounts of thermal wear.

♦ Surface swimming with gear will involve a sidestroke flutterkick. In the sidestroke, forward is toward the front of the

swimmer's body and backward is toward the swimmer's back. Applied force is typically much greater during the forward stroke, and fins are often designed with this fact in mind. When power is needed for both forward and backward kick, like in sidestroke, a straight symmetrical fin may be more efficient for you.

♦ Underwater swimming involves a face down position, where the forward stroke is down and the backward stroke is up towards the surface of the water. In this position, gravity assists with the downstroke and produces a less symmetrical type of thrust than seen with sidestroke kick. You should select a high-tech diving fin with moderate flexibility and an integral type footbox. The fin should have an offset design to allow a more efficient transfer of propulsion force.

♦ For bodysurfing, use short surf fins.

The main principle of fins is to increase the surface area of the foot.

Specific Design Characteristics of Fins:

♦ Size or surface area of fin blade

♦ Stiffness of fin blade

♦ Configuration or shape of fin blade - length and width

♦ Integral footbox versus strap-type fin

♦ "Offset" or angle of pitch between footbox and fin blade

♦ Buoyancy of fin

Physical Attributes Influencing Fin Selection:

♦ If your ankle range of motion is inherently limited, long fins will assist in transmitting lower extremity forces to the water.

♦ If your ankles are inherently flexible, short fins may be more efficient as well as less stressful on relaxed ankle joints.

♦ Your natural kick frequency will also influence your choice of fin stiffness and size. Larger sizes and stiffness produces a slower rate of kicking, while short flexible fins allow a higher kick rate.

Operational Constraints:

♦ Face down versus sidestroke position

♦ Surface versus submerged

♦ Space limitations (SDV)

♦ Thermal protection

The fit of the fin is critical.

If the fin is too tight, the finbox may make your foot cramp up and more susceptible to cold. If it is too loose, energy is lost in the slop between foot and footbox; slop also translates into foot chafe? Booties provide grip for the foot within the footbox and the neoprene acts to even out areas where stress is concentrated.

Other Fin Selection Considerations

Fins vary slightly in buoyancy; about half of sport fin models float and the remainder sink. This may be an operational consideration. In the April 1996 Rodale's Scuba Diving fin test, fins testing as "outstanding11 in the area of power included the expensive

Scubapro Gorilla, Mares/Plana Avanti, Ocean Edge Spectra, and the U.S. Divers Blades. However, so did the IDI Frog Foot and Power Fin models, which have been the standard fins in the Teams for many years.

The authors of the article reveal honestly that, "In spite of extensive research and a multiplicity of designs applied to modern fins, there are still tried and true fins that perform as well as many of the top newer models."

The older, buckle-style strap fasteners have the advantage of being reversible and are far less likely to foul in fishing line or seaweed than fasteners on newer models, many of which have quick-release buckles. The simple straps on older models have no plastic to break, are easy and inexpensive to replace, and can be found in almost any dive store. These fins are also not as slippery on deck as newer designs.

You will need to evaluate individual fin performance carefully. You should not only consider characteristics of the fin, but know your own physical attributes and any particular operational constraints in making your decision.

When buying fins consider:

♦ Size, stiffness, weight, buoyancy, buckles and releases.

♦ Getting the best possible fit; try on fins with booties or other foot gear that you'll be using with the fins.

Face Masks

A face-mask is required for swimming as prolonged exposure to salt water and/or stinging marine organisms may cause eye irritation or injury.

For open water swimming, you should use your face masks.

Open Water Training

There is no substitute for ocean or lake swimming. Training in open water will force you to swim straight and develop a cycle of breathing that allows you to look forward in order to navigate. This is an essential skill for operational swimming. Group swims in open water are an excellent way to maintain fitness and should be used extensively in training programs. Open water training will maximize the training effect of using fins.

For operational open water swimming, the sidestroke with a flutterkick is superior to freestyle.

In rough open water and under operational circumstances you may want to combine a scissor kick with a sidestroke pulling technique to maximize your navigational ability and watch for breaking waves. However, sculling is as important in the sidestroke as it is in freestyle. Both arms should be used to incorporate sculling motions and to stabilize the swimmer's trunk while the kick provides the main thrust. There are stroke efficiency issues with the sidestroke just as there are in other swimming strokes. Stroke coaching is invaluable in developing good technique.

Water Temperature Issues

Cold water is an issue to be addressed by your training in open water. Although the work of swimming generates heat, there is heat loss created by movement of the swimmer into new “unheated” cold water. Thus, open water swimming may require various combinations of passive thermal protective gear, in particular, wet suits. The three determinants for passive thermal protection are:

- Temperature
- Length of the swim
- Effort level

It is important to remember that wet suits operate by allowing the body heat to be transferred to a layer of water caught between the body and the neoprene material of the suit. Convective heat loss from the swimmer's body is greatly reduced by this mechanism and as a result, swimming at a high effort while wearing a wet suit allows the swimmer to generate and retain heat. Guidelines have been developed for training and are presented in this section.

Research has established some known “bench mark” facts about operating in a cold water environment. In very cold water (below 40" F), the unprotected swimmer loses heat faster than an immobile person immersed in the same cold water. Heat generation simply does not keep up with losses.

The immobile person warms the cold water immediately around his body thereby limiting total heat loss. However, in moderately cold water (around 68° F), an elite class swimmer may stay active, and the heat generated by swimming keeps pace with overall losses (although the swimmer may develop cold feet and hands). In this

situation, the active swimmer outperforms the immobile person with respect to maintenance of core body temperature. Currently we do not know the crossover temperature point or the water temperature at which it is better to remain stationary than active in the water for thermal balance.

Passive thermal protection modifies this balance by reducing the convective component of heat loss. As a result, a swimmer may extend training durations beyond those possible without passive thermal protection.

Diving medicine specialists at BUDS have developed guidelines for use of passive thermal protection during training in cold water environments.

Special Open Water Training Issues

It is easy to have chafing from the wet suit around the arms and also for the fins to chafe. Get thin booties without soles for fin use and consider using some vaseline or aquaphor ointment for other chafe points.

If you swim regularly in cold water, your body will undergo some adaptive changes. This will increase your tolerance to some extent. You will also begin to actually crave fatty foods, an instinctual tendency of cold water swimmers to want extra body fat to protect them! This is a natural adaptation, but this may be undesirable for your running and overall fitness.

Surf training is great for honing your aquatic skills and for developing confidence in big water. For body-surfing, use a medium fin, like short surfing fins, that permits quick acceleration but is

small enough not to get caught in moving parts of the wave. Use velcro-elastic "keepers" for your fins unless you are sponsored by a fin manufacturer!

Keep your head down and always surf with an arm extended up over your head.

It is far better if you get folded by a big chopping wave to have your shoulder dislocated than for you to become quadriplegic from a cervical spine injury. Avoid shorebreaks; the waves are unpredictable and going over the falls may yield a screaming descent straight onto the beach sand. Instead try to find a good "grab and release" break where the wave stands up nicely and then breaks back into deeper water.

Another open water issue you may be faced with is that of sharks. They commonly attack solitary swimmers, particularly freestylers: the solitary, beefy organism making arm slaps against the surface of the water. Avoid swimming in places where you may resemble part of the food chain, but even then there appears to be protection in numbers. A good example is La Jolla Cove near San Diego. Here triathletes swim and Great White sharks eat small mammals all in the same day. Avoid swimming in the evening and get out of the ocean if you get bloodied too much in the surf.

Sharks virtually never attack swimmers in groups.

Swimming Pool Gear

Goggles

The most important gear for pool training is a good set of goggles. Get goggles that can be adjusted across the bridge of the nose. The fog-free goggles work better than they used to, but they do lose this quality relatively quickly under hard use and are much more expensive.

Kickboard

A kickboard is essential. They come in a wide variety of sizes and shapes, but all do basically the same thing.

Pullbuoy

A cheap, but essential, piece of training gear, the pullbuoy fits between the swimmer's legs for specific types of swim drills.

Hand Paddles

These are useful to develop the feel of sculling during freestyle pulling.

Zoomers

A unique and expensive short fin, the Zoomer is helpful but not essential. This special fin is designed to allow the swimmer to use flip turns during pool training sessions with minimal interference with technique. Other short fins may be substituted, notably the short, surf fins.

Nose Clips

Many individuals develop low grade nasal reaction to pool water. Use of a nose clip will allow a swimmer to complete some of the backstroke drills presented in this chapter much more comfortably.

Pool Training: Building Strength and Endurance

The major reason to use a pool is the quality of training. Swim sessions may be closely monitored and are safe. Controlled interval workouts used in pool training sessions provide good feedback; the pace clock doesn't lie. Pool sessions allow you to design workouts that vary in intensity and emphasis, which is not possible in open water. Pool training and acquisition of improved stroke skills are elective elements of a training program. Pool training will increase your comfort level in open water, thus enabling you to significantly improve your operational capabilities.

Swimming is not an intuitive activity like running.

Warming Up

Warming-up should consist of at least 400 meters of swimming, along with some kicking and pulling drills. Warming-up is essential for swimming to avoid developing problems of the shoulder joint and upper back.

Target heart rate during warm-up should be about 60% of maximal.

During your warm-up, work on efficient stroke "stealth" swimming] Warming-up is an appropriate time to include stroke drills. This serves the purpose of providing stroke patterning along with the warm-up.

Basic Principles of Interval Training

You need to concentrate on swim training that will enhance endurance: interval swim training will allow this to happen. Interval training sets (for both strength and endurance) are generally comprised of repeated swims lasting 45 seconds to 4 minutes. Basics of interval training include the following:

♦ Swim at a slow to moderate pace for five to ten minutes to warm-up muscles and cardiorespiratory system.

♦ For anaerobic training, sets should be performed until repeat times can no longer he held. There is no magical number of repetitions for a set, but the distance is typically 50 to 100 meters, or a time of about 45 seconds.

♦ Swimming at a prescribed intensity pace for as long as possible is most important. When desired pace can no longer be sustained, the set should be terminated.

♦ Work:recovery ratios play an important part in the type of adaptation that occurs. A 1:1 work:recoverv ratio would he to swim 45 seconds and rest 45 seconds, whereas a 1:2 ratio would be to swim 45 seconds and rest 90 seconds.

♦ To stimulate endurance adaptations, recovery intervals between repetitions should be less than 30 seconds. For maximum benefit, it is best to keep the interval less than 15 seconds.

♦ For anaerobic adaptations to occur, recovery intervals should be in excess of one minute and up to at least twice the duration of

the repetition swim. These effects occur independent of the repetition distance or pace.

♦ The longer the rest interval, irrespective of the distance being repeated, the greater the use of the anaerobic system. With long rests, it takes considerably longer for the aerobic energy system to be reactivated. Short rest intervals keep the aerobic system functioning, particularly during initial recovery.

Interval training is the backbone of a swimming workout.

How the different energy systems can be trained in an interval workout

Swim 1 is a hard effort, short distance and a lot of rest; this type of effort builds the anaerobic (CP) and transitional (Lactate- CP) energy systems. The second swim consists of fewer sets at a longer distance and with shorter rest intervals; this swim would challenge the aerobic system.

Energy Systems Used During Interval Sets

Lactate-CP System

Swim 1:10 X 100 m with 45 sec. rest 10 = Repetitions (Sets) 100 m = Distance in Meters

Aerobic System

Swim 2: 5 X 200 m with 5 sec. rest 5 = Repetitions (Sets) 200 m = Distance in Meters

A swimming pace clock is the best way to time intervals: a diving watch works fine.

Interval Sets - Endurance

Freestyle Swim: 10 x 50 m with only 5 sec. rest

♦ Rest 5 seconds between each swim.

♦ Start with efficient “stealth” stroke, work into distance race pace. Don't ovcrkick.

♦ Try to match your 1000 meter pace with this set.

Freestyle Swim: 50-50-100 m with 5 sec. rest

♦ Swim 2 x 50 meters with 5 seconds rest, then swim 100 meters: Repeat 3X.

♦ This set builds into a 100 meter swim where the swimmer tries to match the pace set in the 50 meters.

♦ Back off of the 50 meters a little to save up for the 100 meters.

♦ If you want, add an extra 15 seconds of rest between each 50-50- 100 to keep the quality up.

♦ A “buildup” set like this will do great things for your endurance and sense of pace.

Freestyle Swim: 10 x 100 m with 10 sec. rest

♦ Rest 10 seconds between each 100 meter swim.

♦ Swim smoothly and efficiently. This is the set where you may exceed your long, slow swimming 1000 meter time!

Breaststroke Swim: 50-50-100 m - 5 sec. rest

♦ Done like the freestyle 50-50-100 set outlined above.

♦ Concentrate on keeping effort level up.

Interval Sets - Strength and Power

Freestyle Swim: 10 x 50 m with 30 sec. rest

♦ Begin at a strong pace. Build to race pace with a strong turn and an extra strong finish. Try to be within 5 seconds of your race 50 meters pace, usually equal to your race 200 meter pace.

♦ At first, try just 5 x 50 meters with 30 second rest.

♦ This is the most power-oriented freestyle set. It will also allow you to discover your true maximal heart rate. If you start to die off at the end, increase your rest a little to keep your pace.

♦ If you are particularly strong and want to build more speed, do this set with zoomers.

Freestyle Swim: 10 x 100 m with 45 sec. rest

♦ Same pace approach as the 50 meter interval set. This is for advanced swimmers with a refined stroke. It will build power, but this set should be used no more than once every two weeks.

♦ The rest interval should be 45 seconds for this length of swim; adjust your interval accordingly.

Breaststroke Swim: 10 x 50 m with 30 sec. rest

♦ Like backstroke, work on hard swimming with about 30 seconds of rest. Breaststroke is very taxing when done hard but like bicycling it is easy to throttle back and have the appearance without the substance.

Integrated Workouts

For pool training it is necessary to integrate your sets into a comprehensive workout. At first you will want to limit your hard sets, but as your fitness improves, hard drills can be extended. It also worthwhile alternating between anaerobic and aerobic workouts. In this way your performance for swimmer operations should be optimized.

Sample Anaerobic and Aerobic/ Endurance Swim Interval Workouts

Anaerobic

600 m warm-up 5 x 50 m with 15 sec rest between each 5 x 50 m with 30 sec rest 5 x 50 m freestyle swim with 45 sec rest 200 m easy swim 5 x 100 m freestyle, 45 sec rest 5 x 100 m freestyle with 90 sec rest 500 m easy swim

Aerobic

400 m warm-up 5 x 200 m freestyle with 30 sec rest 10 x 100 m freestyle, keep distance pace, 10 sec rest

200 m easy swim 5 x 200 m freestyle with 5 sec rest 10 x 100 m freestyle, keep distance pace, 5 sec rest

400 m cool down

Underwater Training

Swimming underwater requires breath holding. While this is an activity that is not endorsed by the diving manual, it may be something you could do. Given this fact, specific training will enhance your performance and extend your operational capabilities. The following rules apply to underwater swim training:

- DO NOT hyperventilate prior to your underwater swim.
- Use a buddy to observe during pool drills.

Varying Your Workout

Swimming workouts should be varied between easy days and hard days. For competitive speed, it is good to swim at least four days a week; this will help keep stroke efficiency. Swimming days provide good relief for tight muscles generated by running and weight training.

Swimming has some specialized weight training techniques. The primary issue is that swimmers have full range of motion of their arms during exertion. Muscle contraction is fairly constant over the entire arm motion requiring balanced power throughout. Weight training must complement this fact, or muscle tightness develops that actually works against the swimmer.

Pulley pulls are excellent weight training techniques for a swimmer. The classic is the lat pull-down station present in virtually all weight rooms and multi-station machines. A better arrangement is for

weights and pulley setups to be individualized for each hand. Pulley pulls are “isotonic” and mimic the constant resistance of water. Weights should be kept on the low side, permitting high speed weightlifting of between 1-1.5 seconds per repetition. Hold slightly at the end of each lift to prevent banging weights and getting thrown out of the weight room.

Swimmers use high reps, never less than 10.

Many dedicated swimmers own an Exergenie, which is a truly simple piece of equipment that permits a realistic workout in freestyle or backstroke. It is a nylon line rigged up through a little cylinder that twists the line and provides resistance. This workout is possible even within the confines of a cramped 688 class (40 - 50 reps) can be done daily because the motion is so much like swimming. Thus, it is a portable weight room for swimmers.

Cross training includes canoeing, rowing, kayaking, and cross country skiing.

All of these involve repetitive arm use in a pattern that is generally complementary to a swimmer's stroke. These sports will impart strength to the shoulder and chest muscles that will help your swimming.

Developing Stroke Skills

Basic stroke mechanics will prohibit you from increasing your respiratory rate (except during backstroke). Because you can't pant, you will quickly become limited by not getting enough oxygen or not getting rid of carbon dioxide before it starts building up. This is

different than in running and is the reason for the universal use of interval training in swim training programs.

Runners often go out for long steady runs, but a swimmer who trains this way becomes a slow and inefficient swimmer.

This section will discuss three main swimming strokes; crawl stroke (usually called freestyle or “free”), breaststroke, and sidestroke. These particular strokes are the most useful to you. Most swimmers use a variety of strokes in a workout to provide cross training and avoid overuse injuries.

Skills must be developed over a long period of time in order for the swimmer to become proficient. Good stroke mechanics are not only necessary to develop speed; injury may occur in swimmers from poor technique. A proper stroke may only be developed by getting feedback from others. This factor makes a buddy system or partner coaching an essential component of your training program. Obtain periodic stroke coaching from a qualified instructor - no matter how good you are.

General Stroke Principles

Water causes a large amount of drag on the swimmer's body, thus streamlining becomes extremely important. The key to swimming fast is reducing drag as much as possible while maximizing propulsive forces.

One specific technique includes rolling from side to side to clear high resistance parts of the swimmer's body for arm recovery. Swimming in salt water is faster than swimming in fresh water because of the increased buoyancy of the swimmer, reducing

resistance. There are many other subtle ways to reduce water drag in swimming, and learning them is one of the benefits of getting coaching from a qualified instructor or swimming coach.

The Strokes

Freestyle

For beginning freestyle swimmers, a pullbuoy will help the swimmer concentrate on proper arm stroke and additionally, help keep the hips positioned high in the water which minimizes drag. Approximately 90% of the work with the freestyle is due to the arm stroke.

The correct arm pull incorporates several elements of sculling. In overall terms, the arm of the swimmer resembles a turning propeller.

Breaststroke

The key to breaststroke is the kick. Propulsion is provided by drawing the feet up towards your body in the direction of motion, and then sweeping both feet backward in a circular motion, pushing motionless water backward with the inside and bottom portions of the swimmer's feet. Coaching is essential to develop good technique as the kick is very subtle.

Pulling is done by a sweeping sculling motion. A good stroke drill to work on for a strong sculling motion is to use only your arms and not your legs, in other words, “pull breaststroke”. This drill develops a feel for the water that is needed for all three strokes.

Sidestroke

Sidestroke is extremely important for you to master. Arm pulling and kicking should be coordinated to maximize thrust and conserve energy over a long swim. It is necessary to learn sidestroke using either side in order to be able to face away from heavy ocean chop and swells. You can't afford to have a favorite side.

Sidestroke is a "stealth" stroke, unlike freestyle. Use a sweeping action with your hand and visualize that your upper hand is like a helicopter blade grabbing still water out in front of you while your bottom hand grabs water ahead and below you.

The power of fins can be used with your flutterkick, not broaching on the surface of the water. Sidestroke is efficient, conserving your energy over a long swim. With fins, the majority of thrust comes from the legs and arm stroke is less important.

Swimming Drills

Fin Drills

Kicking with fins is fantastic training. He careful of using a kickboard too much while training with fins; this may cause back pain. Sidestroke is good but you will need lane lines and flags to prevent careening off course and acquiring a nice scalp laceration. The mainstay of kicking strokes is still prone flutterkick.

Fin kicking drills are essential to building leg strength and specific training duties. These drills are effective when imbedded within a pool workout where there are swimming sets that accentuate arm and chest muscle training. This is because the swimmer’s legs will

be warmed up but relatively fresh and ready for a strenuous workout with fins. Use high numbers of repeats in sets, 10-12, with relatively short rest intervals of 10-15 seconds. A total set length of around 10 minutes is optimal; any longer and the set begins to degrade into a long, slow distance set which is best done in open water.

♦ Fin Sprints: Sprinting 25 meters with fins will allow you to feel flaws in your arm strokes. This drill will consume an extraordinary amount of oxygen and provide a good anaerobic and strength workout for your legs. It also feels great to go fast.

♦ Fin Fartlek: Do this set without a kickboard Kick one length with an easy flutter kick, then flutterkick the next length on your right side with both hands out of the water - effort level high - then back to face down for a length of easy flutter kick, then back at it over a hard length, this time on your left side, again hands out of the water. Repeat several times. This drill is particularly effective in a long pool (45m).

♦ Fin Repeats: Do with a kickboard. Kick flutterkick hard for 50m, rest 10 seconds, repeat for 10 repetitions.

Other Specific Freestyle Drills

♦ One Arm Freestyle: May be done with or without a pullbuoy. Emphasizes body rolling without corkscrewing. This drill will allow the swimmer to concentrate on proper pulling technique.

♦ Catch-Up Freestyle: Hold arm out in front while pulling with the other arm. Recover the pulling arm and then touch hands out in

front before initiating the pull with the other arm. This drill will help timing of pull.

♦ Fist Freestyle: Swim with fists. This will make the swimmer concentrate on forearm sculling. Do this drill without the pullbuoy.

♦ Finger Drag Freestyle: Recover arm with fingers skimming the water. This provides the swimmer with feedback regarding arm and hand position during arm recovery.

Common Problems

Swimmers often develop hypersensitivities and allergies with pool swimming. The source of the problem is the inhalation of chlorinated organic material (guess where this comes from in a public pool). These hypersensitivity reactions may include lung conditions that are quite disabling. Prevention is the key. Ways to minimize your chances of such problems include:

♦ Wearing goggles.

♦ Using a nose clip.

♦ Avoiding any situation where you might breathe a mist or spray that is generated from pool water.

Warming-Up and Stretching

Stretching is not the same as a warm-up.

Many individuals stretch in a misguided attempt to warm-up; however, stretching and warm-up should be considered distinctly different activities. A warm-up prepares the body for the activity

that is to follow. The two types of warm-up are general and activity-specific. Physiologic changes that occur during warm-up include increases in muscle temperature, blood flow, oxygen delivery to the muscles, and skeletal muscle metabolism. Warm-up benefits include injury prevention and an improvement in performance.

A warm-up should always precede any physical activity whether it be stretching, exercise, sports, or other type of training.

Cold muscles don't stretch, and there is a high chance of injury when stretching is performed without first warming up. Stretching (especially dynamic stretching) may be part of (or follow) a warm-up, but should not exclusively comprise the warm-up.

Stretch only after an adequate warm-up has been performed.

General Warm-Up

General (or unrelated) warm-up involves movements (e.g., running in place, jumping jacks, and other calisthenics) that are different from, or unrelated to, the specific activity that is to follow. This type of warm-up should be performed prior to high-intensity activities (e.g., O-Course, power-lifting, “burn-out PT,” gymnastics, etc.) when immediate participation in the actual activity is likely to result in joint or muscle injuries.

Activity-Specific Warm-Up

Activity-specific (or related) warm-up occurs with a low-intensity version of the activity that is to follow. Examples of activity-specific warm-up include a slow jog prior to a long run; slow cycling in preparation for a cycling event; or slow karate moves prior to

practice. A related warm-up starts out slowly and progresses to more intense activity. Depending on the intensity of exercise to be performed, a warm-up of anywhere between 10 - 30 minutes may be required—the greater the intensity of the workout, the longer the warm-up.

All warm-ups should be of sufficient intensity to elevate body temperature; sweating is a good indication that you are ready to move on to the next phase of your workout.

Both general and activity-specific warm-ups may incorporate some type of stretching, especially if the activity to be performed is one of high intensity and imposes a good chance of acute injury. After a short period of warming-up, some pre-exercise stretching should be done.

Specific Warming-Up Activities

O'Course

10-20 min of Calisthenics or Slow Jogging Dynamic Stretching of Major Muscles

A Long Run

10-15 min of Slow Jogging

PT

Jumping Jacks, Slow Jog or Other In-Place Activity for 10 - 20 min Dynamic Stretching of Muscles to be Used in PT

Exercise should not be ended abruptly, but gradually slowed, to avoid pooling of blood in the skeletal muscles, and to facilitate the removal of metabolic end products. Exercise should be followed by a cool-down and stretching session.

Since most of the benefits from stretching occur post-exercise, a 10-15 minute stretching program should follow every exercise session, and should be incorporated as part of the warm-down while the muscles are still warm. Stretches should be slow and static, held for 15-30 seconds, and taken to the point of tightness, not pain. Static stretching provides a good warm-down after a workout, reduces post-workout muscle fatigue and soreness, and is useful for relieving muscle spasms that occur as a result of exercise. Once muscles have been stretched, standing in cool/cold water, or running cool water over the legs or muscles used during the exercise, can also reduce soreness, and seems to speed recovery between exercise bouts.

Training for Specific Environments

Physical training in extreme conditions, such as hot, cold, or high altitude environments, presents special challenges. Even highly accomplished athletes can he quickly overcome by “environmental exposure” injuries if proper preparation is overlooked or if signs and symptoms of impending illness are ignored. To compound matters, many extreme environments tend to be isolated and difficult to access. Proper planning and preparation before entering such areas can help ensure safe and beneficial training.

One way of adapting to a new environment is “acclimation”. Acclimation is defined as the continuous or repeated exposure to

heat, cold, altitude, or some new environment so as to provoke physiologic or biochemical changes that allow you to better tolerate the new environment. Thus, acclimation is the gradual change the body goes through as it adapts to a new environment. This chapter will focus on training under environmental conditions which require acclimation, and also under confined spaces.

Training in Hot Environments

Exercising in hot, humid environment imposes a significant challenge on the body. The human body maintains tight control of body temperature through several different mechanisms. Under conditions which impose large heat loads (example: strenuous exercise or wearing protective gear in a hot environment), the primary mechanism for cooling is evaporation of sweat from the skin or evaporative cooling. Relative humidity is the most important factor governing evaporative cooling: when the humidity is high, evaporation is greatly limited.

Your skin is like the radiator of a car; as the temperature of the body core rises it warms the blood and pumps it to the skin to cool off. Sweat is released at the skin and absorbs the heat from the warmed blood. As sweat is warmed, it is vaporized the same way boiling water turns to steam and thus removes a large amount of heat from the body. Only sweat that evaporates can effectively cool the body; sweat that "drips" is essentially wasted fluid and provides little or no cooling effect. The body maximizes evaporative cooling by:

♦ Increasing Heart Rate: An increase in the heart rate increases blood flow to the skin and results in greater heat transfer to sweat and vapor.

♦ Increasing Sweat Volume: Beginning to sweat earlier and recruiting more sweat glands increases the rate of sweat production, therefore cooling.

How hot is too hot? The degree of danger posed by a hot environment is usually determined by the wet bulb-globe temperature (WB-GT). If the WB-OT is over 87° F (30.5° C) or if no WB-GT is available and the temperature is over 85° F with a relative humidity of 60% or above, exercise should be avoided or undertaken with caution.

Factors that Hinder Body Cooling in the Heat

♦ Humid Heat: As the humidity increases, evaporative cooling slows due to saturation of the air with moisture.

♦ Skin Disorders: Injuries such as deep thermal burns, sunburn or rashes will prevent or hinder sweating.

♦ Clothing: Any clothing that is impermeable to water vapor will compromise cooling.

Heat Acclimation

Adapting to a hot environment can take one to three weeks; for physically fit individuals, 75% of acclimation occurs during the first week of heat exposure. During this time, sustained physical activity is more difficult and onset of fatigue occurs with minimal physical exertion. Acclimation involves two parts:

♦ Cardiovascular adaptations: Changes that gradually lead to a lower heart rate for a given workload or intensity of exercise This is the most rapid change during acclimation to heal.

♦ Sweating: Sweating begins earlier with exertion; sweat rate is higher and can be sustained for longer periods of time. Sweat also becomes more dilute thus saving essential body electrolytes.

Maximizing Acclimation

Maintain Aerobic Fitness

A solid base of endurance training established before you enter a hot environment will ease the cardiovascular strain encountered during acclimation. Pre-acclimation endurance training must be rigorous enough to raise core temperatures for acclimation to be most beneficial. Aerobically fit. individuals will retain heat acclimation longer once removed from a hot environment than less fit personnel. Remember: Aerobic fitness will help speed the acclimation process but is not a substitute for it.

Exercise in a Hot Environment

Any form of physical exercise will hasten acclimation. However, the intensity will be lower than what you are used to. Refer to your local medical officer for guidance. If the environmental conditions permit, gradually increase the intensity of exercise until you reach the desired workload or level of training.

Maintain Adequate Hydration

Acclimation results in an earlier onset of sweating as well as an increase in the sweating rate. These changes translate to an increased need for fluids. Acclimated personnel may produce as much as 8 to 10 liters <8.5 to 10.5 quarts) of sweat per day. Thirst cannot be used as a "measuring stick" for proper hydration. When training in hot environments, a minimum of 10 to 12 quarts of water per day should be consumed, but not more than 5 cups per hour. Drinking at frequent intervals will decrease the risk of a potentially fatal heat stroke.

Maintaining Acclimation

Heat acclimation cannot be maintained unless there is repeated heat expo-sure and even if repeated exposure is maintained, other factors may cause a loss of acclimation. Factors that lead to loss of heat acclimation include:

- Sleep loss
- Alcohol
- Dehydration
- Salt depletion
- Illness/Infections
- Cessation of physical activity

There is some disagreement as to how long it takes to lose acclimation to heat, but generally speaking after 2 weeks of working in a hot environment, it will take 3 to 4 weeks before most of the adaptations arc lost.

Heat Injuries

There are many categories and subcategories of heat injuries. However, there are three classes of heat-induced injury that will be considered here:

♦ Heat cramps are painful contractions of muscles (usually in the extremities) following vigorous exercise. They occur most commonly in unacclimatized personnel. No specific cause is known (possibly depletion of electrolytes), but such cramps usually resolve when acclimation is complete.

♦ Heat exhaustion is a potentially serious injury resulting primarily from dehydration and electrolyte depletion. The affected individual may feel light-headed, dizzy, nauseous, fatigued, or develop a headache. If heat exhaustion is suspected, the injured individual should be placed in a cool location if possible and given replacement fluids by mouth or intravenously.

♦ Heat stroke is a life threatening injury in which the affected individual loses the ability to regulate temperature and is over-come by soaring body core temperatures (greater than 104° K). Such high temperatures can irreversibly injure vital organs and result in death if not rapidly treated. Many factors may contribute to heat stroke — even well hydrated personnel may become victims if they ignore the warning signs and symptoms.

Warning Signs of Heat Stroke

Light-headedness Headache

Confusion Nausea/vomiting

Loss Of Consciousness

Immediate medical attention is necessary to prevent death. Always remember the basics of first aid and check the ABC's first (Airway, Breathing and Circulation). If possible, move the injured person to a cool area and remove all of the person's clothing. Wet the body with a fine mist of water or pour cool water over the body and fan to facilitate cooling. If ice is available, apply bags of ice to the arm pits, groin and sides of the neck. Medical personnel should start intravenous fluids and oxygen if possible and transport the individual to the nearest medical treatment facility.

Many drugs and chemicals can decrease your ability to tolerate the heat, and knowing which ones may interfere with performance can be important in hot environments.

Drugs and Chemicals to be Avoided in Hot Environments

Caffeine Alcohol Decongestants

Atropine and other anticholenergics Antihistamines

Summary for Hot Environments

♦ Prepare by maximizing aerobic fitness — this will greatly help in sudden in-out ops where gradual acclimation is not possible.

♦ Plan work-out to avoid heat of the day.

♦ Optimize acclimation by a carefully scripted exercise program from the medical department.

♦ Plan for decreased physical performance the first two weeks.

♦ Maintain proper hydration.

♦ Be aware of any illness that may predispose to dehydration (diarrhea, vomiting, fever).

♦ Always be aware of the warning signs of heat illness: Pay attention to your body. Slow down or stop if signs or symptoms of heat injury become apparent.

♦ Avoid drugs and other substances that predispose to dehydration or heat injuries.

Training in Cold Environments

Cold climates represent the harshest environments and pose the greatest threat to survive. An unprotected man in an extremely cold environment will perish much faster than when exposed to extreme heat. In cold weather, the human body attempts to maintain a warm core temperature primarily by physiologic mechanisms and behavioral adaptations:

♦ Increased Metabolic Heat Production: This occurs as the body's fuels (carbohydrates, fats and proteins) are metabolized or “burned” at the cellular level. Shivering represents involuntary muscle contractions that can increase the body’s metabolic rate five to six times above normal.

♦ Peripheral Vasoconstriction: Blood vessels near the surface of the skin constrict or narrow in an effort to divert warm blood away from the cool surface of the skin.

♦ Behavioral Adaptations: Mans greatest asset in cold weather is his ability to create a warm micro-environment by wearing appropriate protective clothing or seeking shelter. He can also increase resting metabolic heat production by 10 times through vigorous exercise.

What is a cold environment? As with a hot environment, the temperature alone is not necessarily the best indication of coldness. In the heat, humidity, and in the cold, the wind, can greatly change your comfort level. In the cold, wind accelerates heat loss by replacing the warm layer of air surrounding the body with colder air. As a rule, you can be sure it is a cold environment when the ambient temperature is below 15° F and the wind speed is greater than 25 mph. Such environments pose potential dangers to those exposed for any length of time.

Factors that Compromise Adaptations to Cold

♦ Inadequate Energy Intake: Reduces the ability to generate “metabolic" heat.

♦ Injury or Poor Physical Conditioning: Inhibits ability to generate heat, through vigorous exercise.

♦ Dehydration: Places greater demands on the heart and speeds up fatigue.

♦ Low Percentage of Body Fat: Subcutaneous fat has insulating properties which help protect against heat loss.

♦ Excessive Sweating: Dress appropriately using a layering system and ventilate as necessary to avoid excessive sweating.

Sweat will destroy the insulating qualities of cold weather clothing and cause unwanted cooling by evaporation and freezing

♦ Alcohol: Increases peripheral blood flow which promotes heat loss and causes core temperature to fall more rapidly.

Acclimation to the Cold

Unlike acclimation to hot environments, there is little evidence to suggest that in humans, there is a significant physiologic adaptation to the cold. There is evidence to suggest that hands which are exposed to the cold for 30 minutes per day for three weeks will receive more blood flow and gradually become more "functional". However, there is greater heat loss through hands conditioned in this manner.

Cold Injuries

The spectrum of cold injuries experienced is broad but all can be avoided by wearing appropriate clothing and paying attention for signs and symptoms of cold injuries.

Hypothermia

A lowering of body core temperature below 95" F is not an uncommon cold injury and mild hypothermia is a relatively easy injury to treat. Moderate to severe hypothermia is less common and should be treated as a medical emergency. Some warning signs of a falling body core temperature include:

♦ Uncontrollable shivering

♦ Slurred speech

- Clumsiness
- Slowed thought process
- If shivering stops but all other signs are present - it could be an indication of severe hypothermia

If any of the above signs occur, immediate action should be taken to prevent further injury or death. Always handle personnel suspected of having hypothermia gently - do not allow them to perform vigorous exercise to warm up as this may cause cardiac arrest. Remove wet clothing and place the individual in dry blankets or sleeping bag with one or two other dry and warm personnel. Never completely immerse a hypothermia patient in warm/hot water as this may result in cardiac arrest. Passive rewarming is usually satisfactory for mild hypothermia, but may not be adequate for severe cases.

Gentle rewarming is the safest method of restoring normal body temperature.

Frostbite

Frostbite is a freezing injury which most commonly affects the hands and feet. However, it can occur to any surface of the body that is not adequately protected. Symptoms often follow a progressive pattern to include the initial sensation of cold followed by numbness and eventually pain during rewarming. The skin may appear normal or appear pale. If a frostbite injury is suspected, attempts to thaw the affected tissue should be avoided until there is absolutely no chance of it refreezing.

Frostbitten feet should not be thawed if it is necessary for the injured to walk unassisted to the extraction or medevac site. Rewarming is associated with severe pain and may turn walking wounded casualties into non-ambulatory casualties. All cases of frostbite require evaluation at a definitive medical treatment facility.

How to avoid freezing injuries

♦ Dress appropriately and keep hands and feet as dry as possible.

♦ Do not touch metal with bare hands/skin. Tape frequently touched metals to reduce this risk.

♦ Wear protective goggles when exposed to high wind .speeds such as in snowmobiles, aircraft, skiers.

♦ Use the "huddy system" to check each other for unprotected skin.

Immersion Foot

Also known as "trench foot", this nonfreezing foot injury results in tissue and nerve damage after prolonged exposure of wet feet to the cold (32 to 50° F). Immersion foot can be prevented by keeping feet as dry as possible and by avoiding tight fitting boots.

Nutritional Requirements

Special attention should be paid to nutritional requirements in cold environments. Energy requirements may increase several fold because of the increased work associated with performing physical tasks in cold weather and the caloric losses to shivering which can

rapidly deplete glycogen stores. Carbohydrates are an excellent source of energy for replenishing depleted glycogen.

Summary for a Cold Environment

- Check weather conditions and dress appropriately.
- Allow for a longer warm up.
- Avoid profuse sweating.
- Replenish body fuel (carbohydrates) during endurance events.
- Maintain hydration.
- Avoid drugs that cause dehydration: alcohol, caffeine.
- Be aware of the signs of cold injury.
- Use gentle rewarming for hypothermia victims.

Training at Altitude

An athlete's performance can suffer dramatically when he rapidly ascends to altitude. Several factors contribute to this decrement in performance but the most significant factor is the relative hypoxia or lack of oxygen available to do work at higher altitudes. Many changes occur during extended exposure to high altitudes; most occur after 2 to 3 weeks. The major adaptations that affect performance and ability to do work include:

- Increased oxygen carrying capacity of the blood
- Increased density of blood supply to and within muscle

- Increased oxygen carrying capacity of muscle
- Increased respiratory rate

Decreased oxygen at altitude reduces the maximal aerobic capacity of an athlete by 1% to 2% for every 100 meter (328 feet) rise above 1,500 meters (4,918 feet). Therefore, an elite endurance athlete may only be able to perform at 65% to 85% of maximal aerobic capacity at 10,000 feet when compared to sea level. Athletes that compete in anaerobic events, such as sprinters or weight lifters who perform brief (2-3 minutes) episodes of maximal effort events, may notice no initial difference in performance because sustained maximal oxygenation of muscle tissue is not necessary.

Acute Mountain Sickness

Acute Mountain sickness or AMS is typically a transient mild illness resulting from ascents to altitudes above 8,000 feet (2,440 meters) or ascents at a rate greater than 1,000 feet (305 meters) per day above 8,000 feet. Symptoms include headache, nausea, vomiting, fatigue and poor appetite. The symptoms usually disappear within a few days.

Some individuals, however, may have to descend to gain relief. Life threatening complications of AMS include High Altitude Pulmonary Edema (HAPE) and High Altitude Cerebral Edema (HACE); both require immediate descent. The incidence and severity of AMS may be reduced by taking Acetazolamide (Diamox) 24 to 48 hours prior to and during an ascent. The dosage is 125 mg. by mouth, twice a day for two days, but this medication should only be given under the direction of a physician.

When participating in high altitude operations, you should report any of the following symptoms to your corpsman or medical officer:

- Cough or progressive shortness of breath
- Coughing up blood or frothy spit
- Progressive symptoms of headache
- Mental confusion or difficulty thinking
- Visual disturbances
- Lack of urination in excess of 8 hours
- Excessive irregular breathing

Other Factors that Hinder Performance at Altitude

Temperature

In general, temperature decreases 6.5° C for every 1,000 meter rise in elevation (or 11.7°F/ 3,280 ft.). At extreme altitudes (above 5,000 meters or 16,400 ft.), the combined effects of hypoxia and hypothermia may make sustained aerobic activity extremely difficult if not impossible.

Dry Air

Relative humidity falls as one ascends. Combined with the increased ventilatory rate experienced at altitude, significant water loss can occur from the normally moist respiratory passages. Cold temperatures will also cause an increase in urinary output and together these two sources of water loss can result, in rapid

dehydration. Thirst cannot be used as a "measuring stick'' for hydration status and personnel must constantly replace fluids with frequent water breaks.

Weight Loss

Most people who ascend to 13,000 feet (4,000 meters) or higher will experience a weight loss of 3% to 5% in the first 2 weeks at altitude. Some of this loss is muscle mass and appears to result from a decrease in the size of individual muscle fibers. There are several reasons for this weight loss:

- Increased energy expenditure
- Decreased appetite due to a direct effect of hypoxia and a decreased sense of taste
- Loss of body water
- Acute Mountain Sickness

Acclimation to Altitude

Prolonged exposure to altitude will bring about several physiologic changes and result in improved exercise tolerance at submaximal effort levels. At levels above 10,000 feet (3,050 meters), maximal aerobic capacity is limited and is lowrer than what would be measured at sea level. Below 10,000 feet, maximal aerobic capacity may approach sea level values, but usually only after a 2 week acclimation period. Because of this inability to achieve maximal aerobic capacity above 10,000 feet, elite endurance athletes may

experience mild to moderate aerobic dcconditioning with extended stays at altitude.

Training and Sports Related Injuries

Sustaining either a sudden injury or an overuse musculoskeletal injury can mean loss of work days, forced rest, and pain for a period of days to weeks. More severe injuries result in scar tissue formation at the site of injury. Thus, the purpose of this chapter is to describe:

- Treatments for training-related injuries
- Reconditioning for return to full activity
- Types of training injuries
- Common injuries
- When to seek medical care

The goal is NOT to have you treat your own injuries, but rather to be informed so that you will seek appropriate help when needed. Central to the rapid recovery from training-related injuries is a step-wise reconditioning program which starts immediately after the injury. Such programs are designed to arrest the inflammatory process, promote healing, and accelerate the return to full duty.

Treatments for Training Related Injuries

Sudden, traumatic, or acute injuries to the musculoskeletal tissue quickly result in inflammation, a process characterized by localized warmth, swelling, redness and pain. If left unchecked, however, the inflammatory process rapidly leads to:

- Tissue congestion
- Stiffness
- Weakness
- Decreased range of motion
- Loss of normal function

A highly successful Sports Medicine approach to accelerate the healing of any injury is to first decrease the inflammatory process (swelling, pain and warmth), and then increase the range of motion at the joint. RICE and ISE are the approaches used to achieve these goals.

RICE = Best, Ice, Compression & Elevation

After decreasing inflammation by RICE, range of motion at the joint is achieved through continued use of ice (I), stretching of the injured ligament or tendon (S), and weight bearing exercises (E).

ISE = Ice, Stretching, & Exercise

Reduce Inflammation

RICE (rest, ice, compression, elevation) is appropriate for all strains and sprains. In general, if an operator cannot bear weight on the extremity, rest is indicated and x-rays to rule out a fracture should be completed as soon as practical.

- "REST" means applying no weight or only partial weight to the extremity; crutches should be used for locomotion. "Relative Rest"

means decreasing activities that cause pain and replacing them with other activities that are pain-free.

♦ "ICE" means applying ice. This should continue until swelling has stabilized.

♦ "COMPRESSION" means applying an Ace wrap or similar compression wrap to the injured part for periods of 2-4 hours. Never sleep with a compression wrap applied unless medically advised.

♦ "ELEVATION" means placing the injured part above the level of the heart; this allows gravity to help reduce the swelling and fluid accumulation.

Application of Ice

Ice serves a variety of important roles in the treatment of training and sport injuries, including:

♦ Reduces swelling that accompanies inflammation

♦ Decreases muscle spasm and pain

♦ Allows for less painful range of motion

♦ Enhances blood flow back to the site after it has been removed

The operator should not wait for a medical evaluation before using ice.

All soft tissue or joint injuries, except open wounds, will benefit by immediate application of ice. Ice can be applied either passively or

actively. Passive application is when you take some form of ice: crushed ice, ice slush, an ice pack, or snow and apply it to the injured body part. Active application is when you take the ice (perhaps in water frozen in a cup or bag) and massage the injured part with the ice.

At home, a bag of frozen peas is an excellent way to passively ice the injured part, as the peas easily conform to the swollen area. After 20 minutes, the bag of peas can be tossed back into the freezer for reapplication later. The normal response to ice includes cold, burning, aching and finally numbness over the affected part. This progression occurs over 7-10 minutes.

Ice can be applied either passively or actively. Do not apply ice directly to the skin.

Tips for Applying Ice: Passive and Active

- Apply ice to the area for 20 minutes as soon after the injury as possible.

- Repeat this every other hour the first day, then three times a day after the first day.

- Use ice until swelling decreases: usually 2-3 days.

Caution: To prevent skin or nerve damage, do not keep ice on for more than 20 minutes, especially when applying to the elbow, wrist, or behind/side of the knee.

Range of Motion

The term range of motion is used to describe the extent to which a particular joint can be moved; achieving complete range of motion is the goal, but sometimes injuries restrict the range of motion. During the 20 minute icing session, you should attempt to move the injured part through a pain-free range of motion.

Days later you can attempt a resistance activity which stresses the injured part while moving the joint through a range of motion that can be tolerated. An example would be moving the ankle up and down against resistance applied by holding a towel under the foot. Continued elevation and use of a compression wrap while doing these exercises will retard swelling.

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

NSAIDs are often used as the first treatment for overuse injuries because they are effective: NSAIDs decrease the symptoms due to inflammation (i.e., swelling, pain, tenderness, fever associated with injury). Although they are usually available over-the-counter, they are not a medication to take lightly. NSAIDs are used in training related injuries when there is inflammation caused by:

- Tendonitis
- Bursitis
- Sprains/Strains

In the case of an acute injury which involves bleeding (including bruising) or swelling, NSAIDs should not be started for 2 to 3 days or until the swelling has stabilized.

NSAIDs may cause side effects.

The most frequently reported side effects include:

- Gastrointestinal distress such as nausea, heartburn, or vomiting
- Gastrointestinal ulcers/bleeding
- Increased blood pressure
- Decreased ability of blood to clot
- Exacerbation of asthma
- Potential kidney damage with long-term use

Remember: NSAIDs should not be used, or should be used with extreme caution, in conjunction with alcohol, as both irritate the stomach.

Generic Anti-Inflammatory Agents

Aspirin (Bayer, Aspirin, Ecotrin) Ketoprofen (Orudis)

Diclofenac (Voltaren) Meclofenamate (Meclomen)

Diflunisal (Dolobid) Nabumetone (Relafen)

Etodolac (Lodine) Naproxen (Naprosyn, Anaprox)

Fenoprofen (Nalfon) Oxaprozin (Daypro)

Flurbiprofen (Ansaid) Piroxicam (Feldene, Antiflog)

Ibuprofen (Advil, Motrin) Sulindac (Clinoril)

Indomethacin (Indocin, Indocin SR) Tolmetin (Tolectin 200,Tolectin 600)

If you have stomach or other gastrointestinal tract problems, Tylenol (acetaminophen) may be a better choice for relieving muscle soreness than Ibuprofen- and Aspirin-based products.

Types of Injuries

A variety of injuries can be encountered during different forms of physical training. In this section we will start with those problems that may be relatively minor and cause mild discomfort, and then proceed to more serious injuries that may limit your activities.

Training-Related Muscle Soreness

Delayed soreness in a deconditioned muscle is normal, and is caused by micro-injury. Pain and tenderness typically appear 12 to 48 hours after beginning a training session. Stiffness and soreness are worse after the cool down and resolve again after warming up. This normal process usually persists for 7-12 days and then disappears.

Contusions

A blow to the muscle belly, tendon or bony prominence may cause swelling and bleeding into the tissue and form a contusion. The blood may coagulate and eventually form scar tissue, impeding normal function. Passive ice therapy needs to be started as soon as possible. After swelling has stabilized, start with active icing and then use Cross Friction Massage. This is a simple technique used to

reduce the swelling and congestion. The thumb or index and long fingers are used to apply firm pressure perpendicular to the long axis of the tendon or muscle. The injured part is rubbed in this manner for 10 minutes, four times a day.

Sprains and Strains

Ligaments attach bone to adjacent bone and can be damaged in a fall, an accident, or through overuse. Such injuries are called sprains and include acute back sprains, knee sprains, or ankle sprains. Sprains are graded as mild, moderate or severe. Mild sprains refer to overstretching and microtears of the fibers. A partial tear, with or without instability or looseness, is considered moderate. A severe sprain implies a complete or near complete tear of tendon fibers that results in looseness or instability at the joint.

A sprain is a damaged ligament.

Tendons attach muscle to bone. Muscle or tendon injury is referred to as a strain or tendonitis. Tendonitis, including achilles tendonitis, shoulder tendonitis, hamstring or quadriceps muscle strains, fall into this category.

A strain or tendonitis is an injury to a muscle or tendon.

Mild to moderate lower extremity sprains and strains heal without residual problems if treated early. Primary treatment includes icc and NSAIDs, partial weight bearing with crutches as necessary, and early therapy to maintain range of motion at the joint.

Muscle Cramps

Muscle cramps are common and may be precipitated by prolonged physical activity, high heat and humidity (black flag conditions), dehydration and/or poor conditioning. Cramps are characterized by the sudden onset of moderately severe to incapacitating pain in the muscle belly and may progress to involve other adjacent muscle groups. The first treatment consists of immediate rehydration with a fluid containing electrolytes. After beginning rehydration, further treatment should consist of grasping and applying pressure to the muscle belly and immediately putting the muscle on stretch until the cramp resolves. The calf muscle, for example, would be stretched by flexing the foot toward the head, whereas a thigh cramp would be treated by flexing the knee, bringing the foot to the buttocks.

Fractures

A true fracture involves a break or chip in the hard outer surface of the bone. With few exceptions, true fractures of the lower extremity require a period of immobilization in a cast and supervised care by a medical officer.

Stress fractures differ from true fractures and are most commonly seen in the load-bearing bones of the lower extremities, i.e. pelvis, femur, tibia, fibula and bones of the foot. They are caused by excessive strain on the bone. Bone constantly undergoes remodelling and repair in response to the stress of weight bearing. The repair process is accelerated by rest, and is slowed in times of heavy exercise as with runs, hikes, marches and prolonged training.

When the breakdown process exceeds the bone's ability to repair itself, a stress fracture may result. As the lower extremity bone becomes weakened, weight bearing activity, such as running, may

cause a vague, achy pain at or near the weakened site. The first symptoms of stress fractures are initially poorly localized and often ignored. Later, as the process continues, the bone will become tender in a very localized area and will often ache at night or at rest. Ultimately, if left untreated, continued weight bearing may cause a true fracture within the weakened area of bone. Physical training factors which increase the risk for stress fractures include:

- A change in training surface (grass to asphalt, dirt to concrete)
- A change in shoe wear (worn out shoes or boots or new running shoes or new boots)
- An increase in physical activity (too much, too fast, too soon)

All suspected stress fractures should be evaluated and followed by the medical officer. Treatment for stress fractures include:

- Reduction or avoidance of impact and load bearing activities
- Partial weight bearing with crutches and advancing to full weight bearing when pain free

This process typically takes two to four weeks. Stress fractures are usually not casted when strict non-weight bearing or partial weight-bearing instructions can be assured. The reconditioning process should include swimming or water exercises (such as deep water running) to maintain flexibility and aerobic endurance. A program of lower extremity strengthening exercises should be started as soon as tolerated.

True fractures require a period of immobilization which varies depending on the bone involved. However, after the cast has been removed, the extremity should undergo a reconditioning program.

After the weight-bearing restriction has been lifted, the individual can begin a reconditioning program for running. A return to running should ideally be initiated on a treadmill. This allows the individual to customize increases in duration and speed while monitoring pain at the stress fracture site.

When to Seek Medical Care

Conditions Requiring Immediate Evaluation by Medical Personnel:

- Back pain that radiates into the thigh, leg or foot
- Severe pain
- Numbness
- Joint dislocation
- Suspected fracture
- Any lower extremity injury in which the individual is unable to bear weight
- Pain which limits activity for 3 to 5 days
- Any hip pain which causes a limp