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GET FIT FOR SPORT

Elverys Sports

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WHAT IS FITNESS

The term 'fitness' relates to a general state of good health. More specifically in a sporting context it may be sub-divided into a number of areas:

- Physical fitness: This can be defined as the ability to perform everyday and sporting activities without undue fatigue. An individual's level of physical conditioning is typically associated with their training status and other factors such as nutrition. The primary elements of physical fitness include:
  - Metabolic fitness: how well equipped is your body at creating and using the energy required for your sport.
  - Aerobic fitness: how well your heart, lungs and blood vessels are adapted to delivering oxygen to the working muscles during prolonged exercise. This is also referred to as cardiovascular fitness.
  - Anaerobic fitness: how well you are able to sustain single or repeated short bouts of high intensity exercise.
  - Musculo-skeletal fitness: how well your muscles and skeletal system are adapted to withstand the demands of training and competing.
- Mental fitness: how prepared your mind is for the psychological demands associated with training and competing.

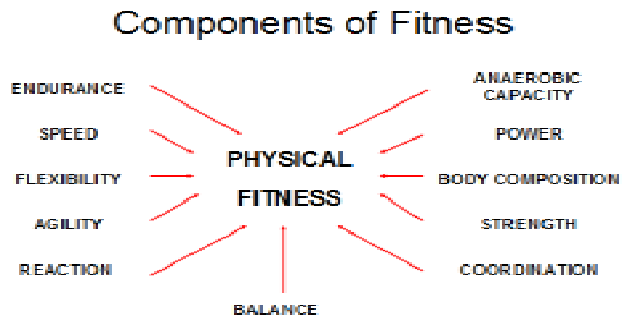
Although other elements will be referred to, this fact sheet will predominantly focus on physical fitness.

HOW FIT DO YOU NEED TO BE?

Most sports require an underlying base level of fitness. Achieving an appropriate level of fitness protects you from injury, and allows you to be reasonably competitive in your sport. It means that you are prepared (or 'fit') enough to last a whole game, or make it to the finish line in your race. Participating in sports at a higher level requires you to be as fit as you possibly can. Unfortunately fitness is transient and specific, in other words you can't store up fitness to use at a later date, and being fit for one sport will not mean that it will give you optimal fitness for another sport. For example, if you only do swimming training, you will be fit for swimming. Understanding the fitness demands of your sport and then determining your own strengths and weaknesses will help you to identify your fitness training needs.

YOUR BODY AND ITS RESPONSE TO EXERCISE AND TRAINING

A basic understanding of the components of fitness and the body's responses and adaptations to training is a useful starting point when looking at how to get fit for sport.



AEROBIC FITNESS

The cardiovascular system consists of the heart, the lungs, and the blood vessels (arteries, veins and capillaries). The working muscles require a steady supply of oxygen (O2) in order to produce energy aerobically. As this process occurs, carbon dioxide (CO2) is also produced, and the body must remove this. When you start to exercise the rate and depth of your breathing increases and brings more oxygen to your lungs. The oxygen is carried by the blood to the heart and then pumped through the arteries to your muscles. The oxygen then leaves the blood, enters the muscle and is used to release energy from the carbohydrates fats and proteins. The carbon dioxide produced is removed from the muscle into the blood and is then carried back to the heart through the veins. The heart then pumps this blood to the lungs where the carbon dioxide is exhaled. More oxygen is absorbed by the blood and the cycle continues. Cardiovascular fitness is simply how good your heart, lungs and blood vessels are at supplying oxygen to the working muscles and how good the muscles are at using this oxygen. The fitter you are the more you can meet the energy demands of exercise with the aerobic system.

Training has a number of positive effects on the cardiovascular system, including:

- An increase in the heart's size allowing it to pump more blood with every beat
- An increase in the number of small blood vessels or capillaries in the muscles to allow more oxygen to be delivered and more carbon dioxide to be taken away
- An increase in enzymes or chemicals which allow the muscle to make energy aerobically

MUSCULOSKELETAL FITNESS

The musculoskeletal system consists of all the muscles, bones, tendons (which attach the muscles to the bones) and the ligaments (which attach the bones to each other). Together these structures allow our body to create the movements required for sport.
Musculoskeletal fitness is concerned with strength, power, endurance and flexibility.

Bone, tendon and ligament strength can be affected by a number of factors including age, heredity and nutritional factors. Weight bearing exercise has been shown to improve strength of bones, tendons and ligaments and a lack of exercise, over a prolonged period of time will weaken these structures.

Unlike bone, muscle will adapt to training relatively quickly; growing larger or changing their characteristics so that they can exert more force or continue contracting for longer. The amount and type of adaptation will depend on several factors including the type of training undertaken, whether you are male or female, your age and genetic factors (inherited from your parents). There are two main fibre types in every muscle: slow twitch and fast twitch. The percentage of fibre type determines, to some extent, whether you are more likely to be a speed-type athlete (predominance of fast twitch fibres) or a more endurance-type athlete (greater slow twitch fibres).

There is a long continuum between fast and slow twitch fibres, and most people fall somewhere in the middle. It is possible that training can have some role in altering the relative proportions of these fibre types. In elite athletes, marathon runners have a much higher proportion of slow twitch fibres to the general population. Similarly a weightlifter will have a higher proportion of fast twitch fibres.

Specific training can affect the strength, power, or endurance of muscles:

i. Muscle strength is the amount of force a muscle can produce. Strength can be improved in two ways. Firstly you can train a muscle to exert more force (or lift a heavier weight) by practicing the movement (or lift) so that the brain learns the appropriate sequence electrical signals to control the muscle contractions. The second way to increase strength is by increasing the size of a muscle by increasing the diameter of the muscle fibres. This is called hypertrophy. By making the muscle exert large forces (or lift heavy weights) you can cause microscopic damage in the muscle fibre and provide a stimulus for the muscle to repair. During this repair process the muscle fibre overcompensates and gradually the muscle fibre increases in size and strength. In reality both of these mechanisms come into effect when an individual undertakes a resistance training programme. A typical maximal strength training programme would typically consist of 4 to 5 sets of 1-3 repetitions of a resistance exercise (or lift) using a weight which is about 90% of your maximum (1RM = one rep max i.e. the greatest amount of weight an athlete can lift for one repetition only). A novice may get significant strength gains using 8-12 reps at 60-70% of 1RM. When weight training it is essential to maintain good weight lifting technique at all times.

ii. Muscle power is the rate at which you develop force and is important in many sports. A weightlifter, for example, must be able to lift a heavy weight quickly. Similarly, a soccer player needs a significant amount of power when striking a ball or accelerating off the mark. Both athletes need to develop more powerful muscles. Power is developed through lifting submaximal weights whilst focusing on the speed of movement. A typical power training session may consist of performing 3-6 repetitions of an exercise using a resistance (or lifting a weight) anywhere between 30-85% of a maximum and repeating this 3-6 times (sets) (ACSM, 2002), with an emphasis on explosiveness and good lifting technique. Another

excellent power training method is plyometrics which involves bounding type of activities however it is important to have a good strength base before incorporating these types of advanced training methods into any programme.

iii. Muscle endurance is the ability of muscle to continue to contract producing the required force, repeatedly. Circuit training using the athlete's own body as the resistance or with light weights is a good way to develop muscle endurance. Repeating an exercise (e.g. press-ups) until the muscles are fatiguing and then taking a rest and repeating the exercise provides the stimulus for the muscle to increase in the number of capillaries, and improve its capacity to create energy anaerobically and removal of waste products such as lactic acid. For more information on circuit training see the circuit training fact sheet.

iv. Flexibility is the range of motion around a joint or series of joints. Flexibility is specific to a joint and different sports require different degrees of flexibility. Flexibility is best improved by regular stretching, either at the end of a session or as a separate training session (perhaps in the evening 3-4 hours after the main training session).

v. Coordination is the ability to integrate sensory system, nervous system and musculo-skeletal system in order to control the independent body parts involved in complex movement patterns. Coordination is particularly important in high skilled activities requiring intricate movement patterns such as gymnastics or slalom canoeing.

vi. Balance is the ability to maintain a stable and specific orientation in relation to the immediate environment. Balance is closely related to other components of fitness such as flexibility, strength and coordination.

vii. Agility is the ability to perform intricate sports specific skills at speed. Agility type movements are generally multi-directional and unplanned by nature. Most field sports such as rugby, soccer and GAA would involve a high level of agility where deceleration speed is as important as acceleration speed.

viii. Body Composition plays an important role in almost every sport. Body weight is predominantly divided into muscle, fat and bone. Generally sports participants should strive to have a relatively low fat content and a high muscle content. It is important to remember that some fat is essential for normal bodily function. In contrast excess fat can impair performance.

MENTAL FITNESS

Mental fitness refers to the readiness of the athlete to cope with the psychological pressure of training and competing, as well as coping with the effect his or her exercise regime has on their normal life outside of their sport. For further information on mental fitness you should consult an accredited sports psychologist in the Service Directory available from the Irish Institute of Sport, or read the Coaching Ireland publication 'Success from Within' (Hackett, 1998). Sports psychology services are available free of charge to carded athletes.

EXERCISE AND THE ENERGY SYSTEMS

There are three major ways that your body can meet the energy requirements in sport. The body uses all these systems but the predominant source of energy depends on the intensity, duration and type of exercise that you are doing.

1. Immediate Energy (Creatine Phosphate system (ATP-CP))

   The ATP-PC system produces energy very rapidly. It uses two fuels Adenonsine triphosphate (ATP) and Creatine phosphate (CP), which are stored in your muscles. High levels of power can be generated using this energy source. It is used at the beginning of exercise, or for short high intensity bursts of exercise (e.g. lifting a weight, throwing a shot put, or during a short sprint). Initially the small stores of ATP are used to provide energy for muscle contraction. These are supplemented by the small, but renewable fuel CP, which is stored in the muscles. During maximal exercise, together these two energy stores ATP and CP last approximately up to 8

seconds only. Renewing this source is done rapidly and automatically by the body immediately after you stop exercising or reduce the intensity of exercise.

2. **Short-Term Energy (Anaerobic or Lactic Acid system)**
   The anaerobic system (meaning "without oxygen") is also very good at supplying energy quickly and is useful for high intensity exercise. This system uses carbohydrates (stored in the body as glycogen), from the food you eat, which is broken down to release energy. The length of time you can exercise using primarily this energy source, depends on:
   - The intensity of the exercise (the higher the intensity, the less time it is available)
   - The fuel you have available to burn
   - How well trained you are in utilising this energy and in removing its by-products

   Unfortunately anaerobic production of energy creates a by-product called lactic acid. Lactic acid [HLa] is composed of two substances, a hydrogen ion [H+] and a lactate ion [La-]. Accumulation of the [H+] leads to the following:
   - Pain and a burning sensation in the exercising muscles
   - An increase in the rate of breathing, and ultimately
   - An inability to continue exercising at such a high intensity due to impaired muscle contraction and function

   If you were only using anaerobic energy production, you would only be able to continue exercising at very high intensities (e.g. sprinting) for 15-30 seconds (see Table 1).

   The anaerobic energy system will, however, still be the predominant energy source during high intensity exercise lasting up to about 2 minutes. Training the anaerobic system usually involves interval training, where the intensity of intervals and the work:rest ratio can be varied to achieve different results.

3. **Longer-Term energy (Aerobic system)**
   The aerobic system (meaning "with oxygen") is the most energy efficient, i.e. it produces the most amount of energy per gram of fuel. This system utilises all three macronutrients (fats, carbohydrates and proteins) as energy sources, in the presence of oxygen to release energy. The major disadvantage of the aerobic system is that it supplies energy relatively slowly, and hence the intensity of the exercise you would be capable of maintaining is relatively low. It is the primary source of energy for prolonged endurance activity.

TABLE 1

Energy Production method	Fuel	Energy liberated (ATP produces a unit of energy)	Time available*	By products
Phosphocreatine (ATP-PC)	Creatine Phosphate	1 ATP	Up to 8secs	Nil
Anaerobic	Glycogen	3 ATP	15-30secs	Lactic Acid
Aerobic	Glycogen Fats	39 ATP 129 ATP	Almost unlimited	Carbon dioxide & water