CHAPTER 15

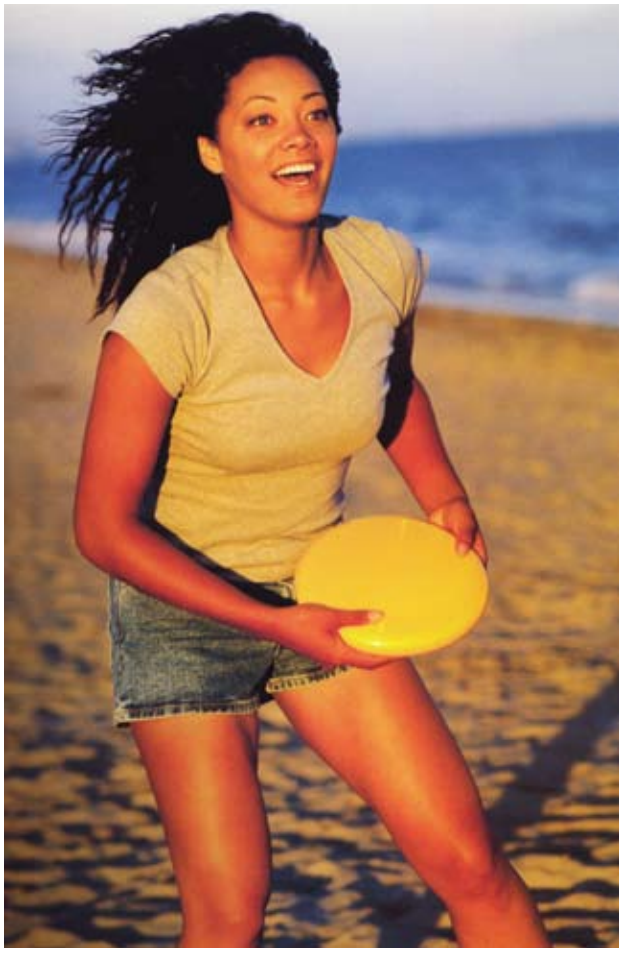
Enhancing Health, Study, Work, and Play Through Physical Fitness

After completing this chapter you should be able to:

- identify and discuss the various components of physical fitness;
- describe the contribution of physical fitness to overall health;
- evaluate the effects of various training methods on performance;
- examine your own physical fitness level and develop an awareness of personal fitness requirements;
- adapt physical fitness and activity programs to address personal needs.

The health, enthusiasm, and creativity of a well-developed personality depend to a great degree upon general fitness levels. Fitness is your functional readiness and level of effectiveness that are required for everything you do. It involves the ability to adapt to the demands and stresses of daily life and is directly related to the amount and intensity of your physical activity. The term fitness is used in many ways and has many dimensions, including physical, emotional, social, and intellectual. The focus of this chapter will be on physical fitness.

Physical fitness is more than just a concept – it is a way of life. It incorporates many components important for health, such as cardiorespiratory endurance; flexibility; muscular strength, power, and endurance; and body composition. Each of these components offers unique benefits and advantages that affect your health in a positive way. Engaging in physical exercise provides numerous benefits that help you control your weight, manage stress, and boost your immune system, as well as protect you against disease. Not only does exercise help you look and feel good, but it allows you to have fun while achieving a state of health and vitality. Fitness need not be boring and monotonous, or restricted to running and cycling; there are many options available, and all you need to do is discover what activities interest you most. Exercise is one of the most important, and indeed, most controllable, factors affecting your general health.



General physical fitness forms the basis for sport-specific fitness and is ultimately related to it. High levels of general fitness are of utmost importance to athletes who strive to achieve high levels of performance. High levels of general fitness constitute important prerequisites for the effective and optimal development of sport-specific fitness. Both develop on the basis of the training principles governing exercise.

In order to get the most out of exercise and physical activity, you need the basic knowledge and an understanding about how to exercise properly and most effectively. This chapter will provide you with concepts related to components of fitness and equip you with basic knowledge governing training principles and their interrelationships.

Definition of Terms

Physical fitness can be defined as the ability of the body to adjust to the demands and stresses of physical effort and is thought to be a measure of one's physical health. In contrast, **physical activity** is defined as "any movement carried out by the skeletal muscles requiring energy." The term **exercise** is considered to be a subset of physical activities that are planned, structured (usually repetitive bodily movements), and designed to improve or maintain physical fitness.

Although physical activity and physical fitness are related measures, physical fitness should be distinguished from physical activity. Physical fitness is an achieved condition that limits the

Figure 15.1 The components of physical fitness.

amount of physical activity that can be performed. A physical activity such as walking, cross-country skiing, or swimming might be considered exercise by an unfit person, while considered physical activity by someone who is very fit. The point is that a physical activity–exercise continuum exists. It demonstrates the specific nature of exercise and physical activity. How much activity, what type, how intense, and how often one should exercise are all important questions that should be considered before any exercise program is designed. In what follows, the terms exercise and physical activity are used interchangeably.

Components of Physical Fitness

Physical fitness is achieved when all of the physiological systems of the body are functioning efficiently to meet the physical demands of everyday activities. The components of physical fitness include muscular strength, muscular and cardiorespiratory endurance, flexibility, psychomotor ability, and body composition (Figure 15.1).

Muscular Strength

Muscular strength is commonly measured as a maximal value and can be defined as the ability of a muscle or muscle group to exert force against a resistance. Thus, strength and force are synonymous. The force generated by a muscular contraction may be applied against a movable object, as in weightlifting, or against a fixed object, such as the starting blocks in sprinting. Force is the product of mass times acceleration ($F = m \cdot a$), and when a force is applied through a distance (D), work (W) is accomplished ($W = F \cdot D$). It follows that the greater the mass of a muscle, the greater its capability of generating force (see Chapter 5). Think of sports that require great strength. Do the athletes that participate in these sports have large muscles?

Power

As defined in Chapter 5, **power** is the ability to overcome external resistance at a high rate of muscular contraction. It is the force that can be generated at speeds characteristic of the activity to overcome gravity (see discussion on gravity in Chapter 8) and thus accelerate the body or an implement. The ability to exert force is in turn dependent on muscular strength. Thus, power is an important derivative of muscular strength and is decisive in performance in most sports and many recreational activities (Figure 15.2; also see discussion on power in Chapter 5).

Muscular Endurance

Muscular endurance is defined as the ability of

Agonist–Antagonist Training

When planning training, care must be taken to include exercises that stimulate both the agonists (working muscles) and the antagonists (counteracting muscles; see discussion on muscle teamwork in Chapter 4). A program that focuses only on increasing agonist strength tends to shorten the agonist muscles and weaken the antagonist muscles. This results in a change in the proportion of strength between agonists and antagonists, which under normal circumstances is well balanced. This shift in strength equilibrium can result in impaired joint positions and make articular cartilage and muscles (especially the tendons) prone to disease and injury.

Thus, a program that includes exercises to develop the biceps should also include exercises to enhance the triceps; trunk extensor training should be complemented with trunk flexor training. This approach to strength training is referred to as **agonist–antagonist training** (Figure 15.3).

To achieve a balanced development of strength, your strength program must ensure a balance between the training of agonists and antagonists.

Figure 15.2 Activities requiring explosive power.

a muscle or muscle group to sustain a given level of force (static exercise) or to contract and relax (dynamic exercise) repeatedly at a given resistance. Static exercises involve sustained contractions, which often compromise blood flow. As a result, oxygen is rapidly used up and metabolic by-products accumulate, causing fatigue. Performing a flexed arm hang will provide you with this experience. Your heart and lungs do not have much trouble performing during a flexed arm hang, but your arm muscles (local muscle group) feel a strong burning sensation and fatigue rapidly.

In contrast to static exercises, dynamic exercises involve continuous rhythmical contractions and relaxations that allow for oxygen to be continually delivered to the muscle and metabolic by-products to be removed. Thus, other physiological systems play a greater role, and depending upon intensity, fatigue may take longer to develop. For example, during cycling, in addition to your leg muscles requiring muscular endurance, your cardiorespiratory system is also involved. Exercises that employ large muscle groups for prolonged periods of time such as distance running, cross-country skiing, cycling,

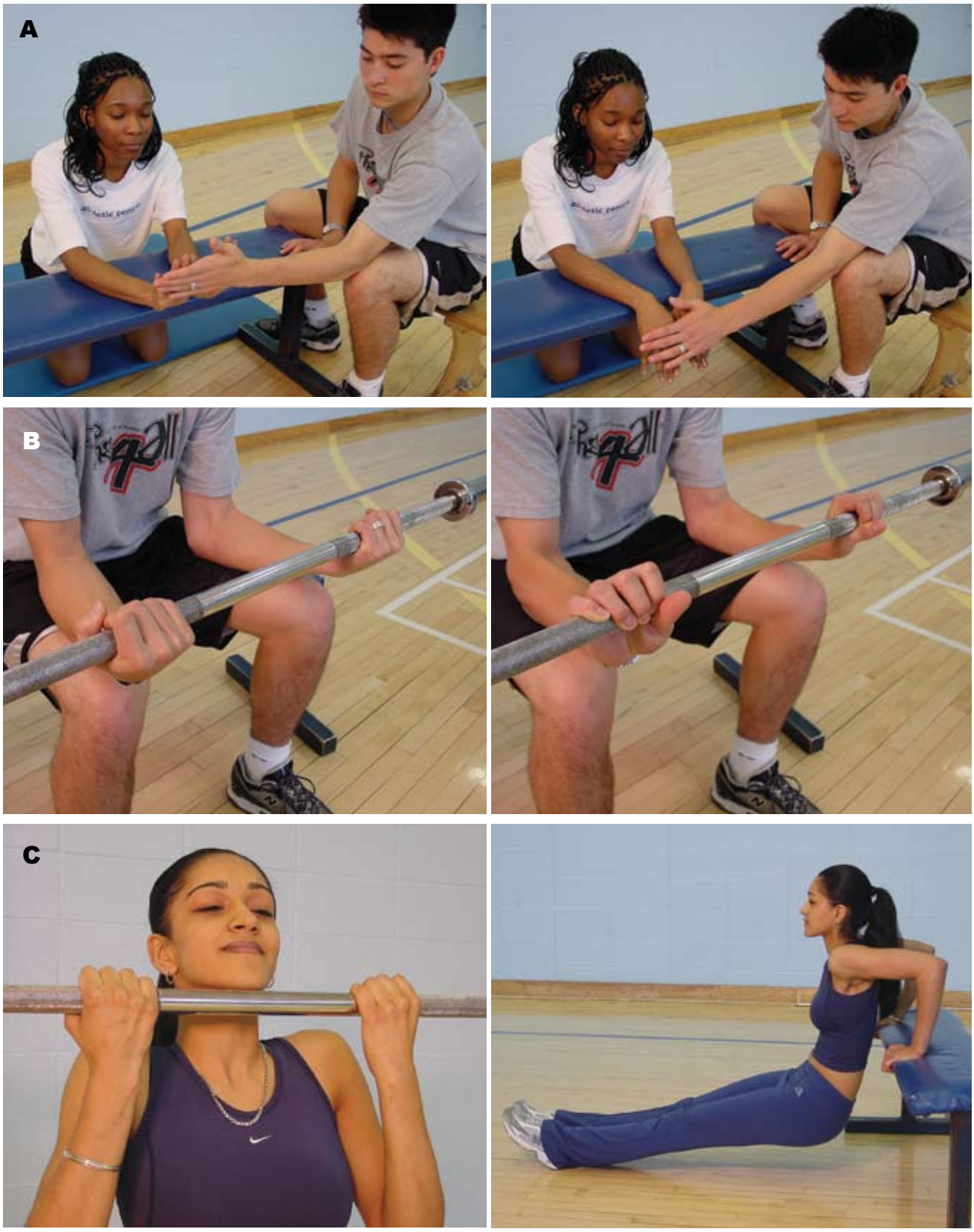


Figure 15.3 Agonist–antagonist training. **A.** Using partner-assisted exercises. **B.** Using free weights. **C.** Using one's own body weight.

or swimming involve cardiorespiratory endurance, another important component of physical fitness (Figure 15.4).

Cardiorespiratory Endurance

As its name implies, **cardiorespiratory** (also called **cardiovascular**) **endurance** or **fitness** involves both the heart (cardio) and the lung (respiratory) systems. A major function of the cardiorespiratory system is to provide oxygen to the tissues. The maximal rate at which the body can take up, transport, and utilize oxygen is known as **aerobic power** or endurance, which is expressed as maximal oxygen uptake, or $\dot{V}O_2$max. $\dot{V}O_2$max is also the maximal rate of aerobic metabolism and is the single most important criterion of physical fitness (see discussion on aerobic power in Chapter 6).

Cardiorespiratory fitness is the ability to produce energy through an improved delivery of oxygen to the working muscles. It is needed for exertions over relatively longer periods of time, regardless of the activity. It is intimately related to muscular endurance because the working muscles rely on the oxygen supply sent by the pumping heart, delivered via the blood, and used by the muscles. The major improvements or training effects related to cardiorespiratory endurance were discussed in Chapter 6.

Maximal Oxygen Uptake ($\dot{V}O_2$max)

$\dot{V}O_2$max can be measured, estimated, or predicted in many ways. Measuring the $\dot{V}O_2$max of a person

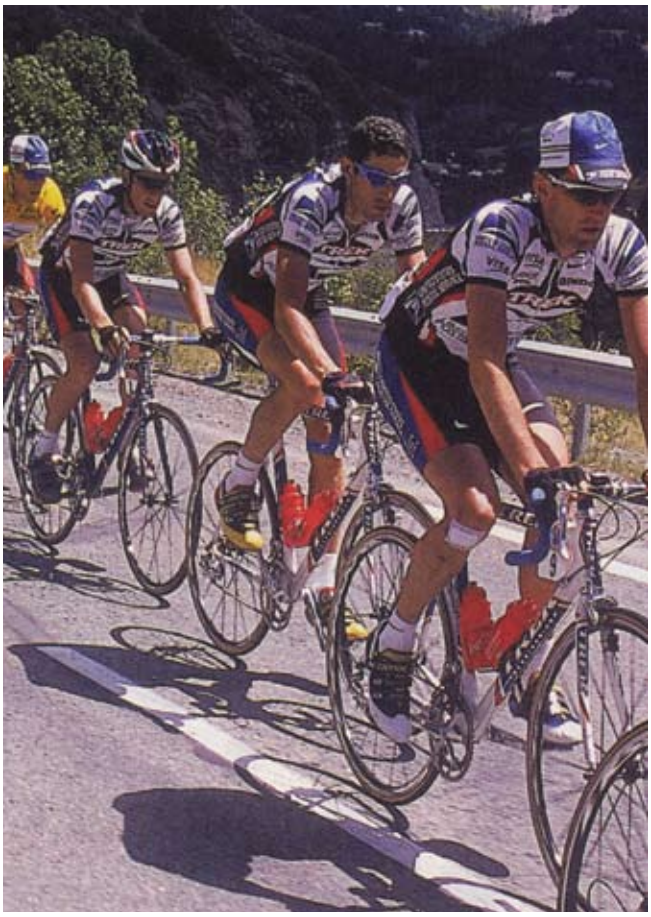


Figure 15.4 Performances in rowing, cycling, and cross-country skiing are based on muscular and cardiovascular endurance.

running on a treadmill involves having a person run at a given speed or workload for a few minutes (2 to 3 min) (Figure 15.5) while oxygen uptake, or consumption, is measured over a period of time (2 to 3 min) at each workload. The workload is gradually increased by increasing the speed or the treadmill slope. At each new workload, the individual demand for oxygen increases (i.e., as the workload is increased, more oxygen is taken up by the lungs, delivered by the heart, and utilized by the muscles). However, eventually a point will be reached where the increased workload cannot be supported by an increase in oxygen uptake. Oxygen consumption is said to have reached a plateau, or reached a maximal value. This plateau is known as one's **$\dot{V}O_2$max**.

Prediction of $\dot{V}O_2$max With each new workload, as more oxygen is required, the heart will pump more blood, delivering more oxygen to the exercising muscles. Thus, at each new workload the heart rate will also increase and eventually reach a maximal value. The linear relationship between heart rate and workload that exists over a given workload range is the basis for estimations or predictions of $\dot{V}O_2$max.

Absolute $\dot{V}O_2$max $\dot{V}O_2$ is expressed in an absolute manner as a **volume per unit time**, liters per minute (L/min). In general, an **absolute $\dot{V}O_2$max** measurement is related to mass, especially muscle mass. Larger individuals usually have higher $\dot{V}O_2$max values because of their greater

Figure 15.5 Testing for $\dot{V}O_2$max can only be carried out in a laboratory setting.