

# UNIT FOUR

## HEALTH RELATED COMPONENTS OF FITNESS AND PRINCIPLES OF EXERCISE PRESCRIPTION

### 4.1. Health Related Components of Fitness

The **overall goal** of a total health related physical fitness program is to **optimize the quality of life**. The **specific goals** of this type of fitness program are to **reduce the risk of disease, to improve total physical fitness** so that, daily tasks can be completed with less effort and fatigue.

Exercise scientists do not always agree on the basic components of physical fitness. However, most do agree that the **five major components** of total health-related physical fitness are:

- ✚ cardiorespiratory endurance,
- ✚ muscular strength,
- ✚ muscular endurance,
- ✚ flexibility and
- ✚ body composition

#### 4.1.1. Cardiorespiratory Fitness

##### **Meaning and Concepts of Cardiorespiratory Fitness**

**Cardiorespiratory fitness:** (sometimes called **aerobic fitness or cardiorespiratory endurance**) is considered to be a key component of health-related physical fitness. It is a **measure of a heart's ability to pump oxygen-rich blood to the working muscles during exercise**. It is also a measure of the **muscle's ability to take up and use the delivered oxygen to produce the energy needed** to continue exercising. In practical terms, cardiorespiratory endurance is the **ability to perform endurance-type exercise** such as (distance running, cycling, swimming, etc.). The individuals that have **achieved a high measure of cardiorespiratory endurance** are generally capable of **performing 30 to 60 minutes of vigorous exercise without undue fatigue**.

#### 4.1.2. Muscle Fitness

##### **Meaning and Concepts of Muscle Fitness**

There are **two components** of muscle fitness: **muscular strength and muscular endurance**.

**Muscular strength:** Is the **maximal ability of a muscle to generate force**. It is evaluated by how much force a muscle can generate **during a single maximal contraction**. Practically, this means how much weight that an individual can lift during one maximal effort.

Muscular strength is important in **almost all sports**. Sports such as football, basketball, and events in track and field require a high level of muscular strength. Even non-athletes require some degree of muscular strength to function everyday life. For example, routine tasks around the home, such as lifting bags of groceries and moving furniture, require muscular strength. **Weight training results in an increase in the size and strength of muscles**.

**Muscular Endurance:** Muscular endurance is defined as the **ability of a muscle to generate force over and over again**. Although muscular strength and muscular endurance are related they are not the same. These two terms can be best distinguished by examples. An excellent example of muscular strength is a **person lifting a heavy barbell during one maximal muscular effort**. In contrast, muscular endurance is illustrated by a **weightlifter performing multiple lifts or repetition of a lightweight**.

### **Muscle Structure and Contraction**

**Muscle Structure:** **Skeletal muscle** is a **collection of long thin cells called fibers**. These fibers has surrounded by a **dense layer of connective tissue called fascia** that holds the individual fibers **together and separates** muscle from surrounding tissues. Muscles are attached to bone by **connective tissues known as tendons**. Muscular contraction causes the **tendons to pull on** the bones, thereby causing movement.

**Muscle Contraction:** Muscle contraction is regulated by **signals coming from motor nerves**. Motor nerves originate in the **spinal cord and send nerve fibers** to individual muscles throughout the body.

### **Types of Muscle Contractions**

Muscle contractions are classified into **two major categories**:

- ✦ isotonic and
- ✦ isometric.

**Isotonic** (also called dynamic) **contractions**: are those that result in movement of a body part. Most exercise or sports skills utilize isotonic contractions. For example, lifting a dumbbell involves movement of a body part and is therefore classified as an isotonic contraction.

**An isometric** (also called static) **contraction**: requires the development of muscular tension but results in no movement of body parts. A classic example of an isometric contraction is, the individual exerting force against an iron bar mounted on the wall of a building; the muscle is developing tension but the wall is not moving and therefore neither is the body part. Isometric contractions occur commonly in the postural muscles of the body during sitting or standing; for instance, they are responsible for holding the head upright.

**Concentric contractions** are isotonic muscle contractions that result in **muscle shortening**. The upward movement of the arm is an example of a concentric contraction. In contrast, eccentric contractions (Also called negative contractions) are defined as contractions in which the muscle exerts force while it lengthens. An eccentric contraction occurs when, for example, an individual resists the pull of a weight during the lowering phase of weight lifting. Here, the muscle is developing tension, but the force developed is not great enough to prevent the weight from being lowered.

**Isokinetic Muscle Contractions** are concentric or eccentric contractions performed at a constant speed. That is, the speed of muscle shortening or lengthening is regulated at a fixed, controlled rate. A weight-lifting machine that controls the rate of muscle shortening generally accomplishes this.

### **Muscle Fiber Types**

There are three types of skeletal muscle fibers: Slow twitch, fast twitch, and intermediate. These fiber types differ in their speeds of contraction and in fatigue resistance. Most human muscles contain a mixture of all three fibers types. Before beginning a strength-training program, it is helpful to have an understanding of each.

**Slow-Twitch Fibers**: As the name implies slow-twitch fibers contract slowly and produce small amounts of force; however, these fibers are highly resistant to fatigue. Slow-twitch fibers, which are **red** in appearance, have the capacity to produce large quantities of ATP aerobically, making them

ideally suited for a low-intensity prolonged exercise like walking or slow jogging. Further, because of their resistance to fatigue, most postural muscles are composed primarily of slow-twitch fibers.

**Fast-Twitch Fibers:** Fast-twitch fibers contract rapidly and generate great amounts of force but fatigue quickly. These fibers are **white** and have a low aerobic capacity, but they are well equipped to produce ATP anaerobically. With their ability to shorten rapidly and produce large amounts of force, fast-twitch fibers are used during activities requiring rapid or forceful movement, such as jumping, sprinting, and weight lifting.

**Intermediate Fibers:** Are although more **red** in color, possess a combination of the characteristics of **fast- and slow-twitch fibers**. They contract rapidly, produce great force, and are fatigue resistant due to a well-developed aerobic capacity. Intermediate fibers contract more quickly and produce more force than slow-twitch fibers but contract more slowly and produce less force than fast-twitch fibers. They are more fatigue resistant than fast-twitch fibers but less fatigue resistant than slow-twitch fibers.

#### 4.1.3. **Flexibility**

##### Meaning of Flexibility

The body is flexible. It is supposed to be flexible. You must be able to bend and reach that something you dropped on the floor. You must be able to zip the back of your favorite dress on your own. You must be able to reach that book you need to read at the top shelf. These are simple activities. Nothing grand about them, you merely stretched out a bit. However, if there are difficulties in doing such simple motions, then you have to stretch your limits. You already need a stretching program.

**Flexibility** is the ability to move joints freely through their full range of motion. Flexible individuals can bend and twist at their joints with ease. Without routine stretching muscles and tendons shorten and become tight, this can retard the range of motion around joints and impairer flexibility. Individual needs for flexibility vary. Certain athletes require great flexibility in order to accomplish complex movements. The average individual requires less flexibility than the athlete however; everyone needs some flexibility in order to perform activities of daily living. Research suggests that flexibility is useful in preventing some types of muscle-tendon injuries and may be useful in reducing low back pain.

##### Stretching Techniques

Though there are a number of stretching techniques, three kinds of stretching techniques are commonly used to increase flexibility: ballistic, static, and proprioceptive neuromuscular facilitation. However, because **ballistic** stretching promotes the stretch reflex and increases the risk of injury to muscles and tendons, only the static and proprioceptive neuromuscular facilitation methods are recommended. A brief discussion of each of these stretching techniques follows.

### **Static Stretching**

Static stretching is extremely effective for improving flexibility and has gained popularity over the last decade. Static stretching slowly lengthens a muscle to a point at which further movement is limited (slight discomfort is felt) and requires holding this position for a fixed period of time. The optimal amount of time to hold the stretch for maximal improvement in flexibility is unknown. However, most investigators agree that holding the stretch position for **20 to 30 seconds** (repeated three to four times) results in an improvement in flexibility. Compared with ballistic stretching, the risk of injury associated with static stretching is minimal. Another benefit of static stretching is that, when performed during the cool-down period, it may reduce the muscle stiffness associated with some exercise routines

### **Proprioceptive Neuromuscular Facilitation**

It is a relatively new technique for improving flexibility. Proprioceptive neuromuscular facilitation (PNF) combines stretching with **alternating contracting and relaxing of muscles**. There are two common types of PNF stretching: **contract-relax** (C-R) stretching and **contract-relax/antagonist contract** (CRAC) stretching. The CR stretch technique calls for first contracting the muscle to be stretched. Then, after relaxing the muscle, the muscle is slowly stretched. The CRAC method calls for the same contract-relax routine but adds to this the contraction of the antagonist muscle, the muscle on the opposite side of the joint. The purpose of contracting the antagonist muscle is to promote a reflex relaxation of the muscle to be stretched.

#### **4.1.4. Body composition**

Meaning of Body Composition

The term body composition refers to the relative amounts of **fat and lean body tissue** (muscle, organs, bone) found in your body.

The rationale for including body composition as a component of health related physical fitness is that having a high percentage of body fat (a condition known as obesity) is associated with an increased risk of development of type 2 diabetes and contributes to joint stress during movement. In general being over fat elevates the risk of medical problems. Lack of physical activity has been shown to play a major role in gaining body fat. Conversely, regular exercise is an important factor in promoting the loss of body.

### ***Health Risks Associated With Over Fatness***

***Obesity has been elevated from a secondary to a primary risk factor for heart disease.*** Prior to 1998, obesity was considered to be a secondary risk factor for heart disease. American heart Association classifies obesity as a primary risk factor, along with high blood lipids, high blood pressure, tobacco use, and sedentary living.

***Physical fitness provides protection from the health risk of obesity.*** Recent research suggests that people who are above normal standards for BMI are not especially at risk if they participate in regular physical activity and possess relatively high levels of cardiovascular fitness.

***Over fatness and obesity can contribute to degenerative disease, health problems, and even shortened life.*** Some disease and health problems are associated with over fatness and obesity.

***Heart disease is not the only disease that is associated with obesity.*** Diabetes is another leading killer that is associated with all components of metabolic fatness, including obesity. The incidence of diagnosis this disease has increased six fold in the past 40 years. Recent studies also indicate a significant increase in risk for breast cancer among the obese. High blood pressure asthma, and back pain are other conditions associated with obesity.

***Excessive abdominal fat and excessive fatness of the upper body can increase the risk of various diseases.*** The location of body fat can influence the health risk associated with obesity. A variety of terms are associated with the location of body fat. Fat in the upper part of the body is sometimes referred to as “Northern hemisphere” fat and a body type high in this type of fat is sometimes called the “apple” shape (see figure 4.1). Upper body fat is also referred to as android fat because it is more characteristic of men than women. Postmenopausal women typically have a higher amount of upper body fat than premenopausal women. Lower body fat, such as in the

lower hip and upper legs, is sometimes referred to as —southern hemisphere fat. This body type is sometimes called the —pear shape. Lower body fat is also referred to as gynoid fat because it is more characteristic of women than men.

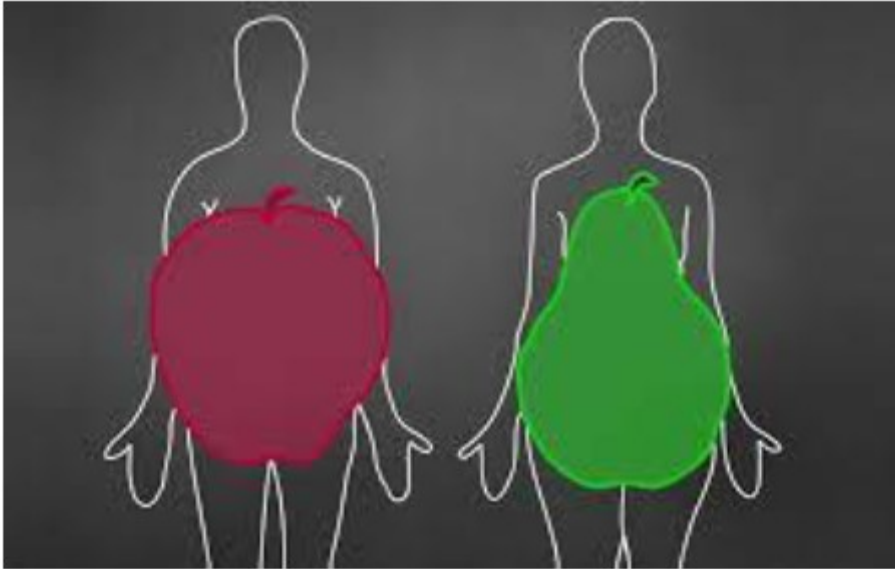


Figure 4.1 Body shape illustration

Body fat that is located in the **core of the body** is referred to as central fat or **visceral fat**. Visceral fat is located in the abdominal cavity (see figure 4.1) as opposed to **subcutaneous fat**, which is located just **under the skin**. Though subcutaneous fat (skinfold measure) can be used to estimate body fatness, it is not a good indicator of central fat. A useful indicator of fat distribution is the waist-to-hip circumference ratio. A high waist circumference relative to hip circumference yields a high ratio that is indicative of high visceral fat. Visceral fat is associated with high blood fat levels as well as other metabolic problems. It is also associated with incidence of heart attack, stroke, chest pain, breast cancer, and early death. The ratio provides an indicator of both upper body fatness and visceral fat.



Figure 4.2 Illustration of the location of body fat

### ***Health Risks Associated With Excessively Low Body Fatness***

Excessive desire to be thin or low in body weight can result in health problems. In western society, the near obsession with thinness has been, at least in part, responsible for eating disorders. Eating disorders, or altered eating habits, involve extreme restriction of food intake and/or regurgitation of food to avoid digestion. The most common disorders are anorexia nervosa, bulimia, and anorexia athletica. All of these disorders are most common among highly achievement-oriented girls and young women, although they affect virtually all segments of the population.

***Anorexia nervosa is the most severe eating disorder.*** If untreated, it is life threatening. Anorexics restrict food intake so severely that their bodies become emaciated. Among the many characteristics of anorexia nervosa are fear of maturity and inaccurate body image. The anorexic starves him / herself and may exercise compulsively or use laxatives to prevent the digestion of food in an attempt to attain excessive leanness. The anorexic's self-image is one of being too fat, even when the person is too lean for good health. Assessing body fatness using procedures such as skinfolds and observation of the eating habits may help identify people with anorexia.

***Bulimia is a common eating disorder characterized by bingeing and purging.*** Disordered eating patterns become habitual for many people with bulimia. They alternate between bingeing and purging. Bingeing means the periodic eating of large amounts of food at one time. A binge might occur after a relatively long period of dieting and often consists of junk foods containing empty calories. After a binge, the bulimic purges the body of the food by forced regurgitation or the use of laxatives. Another form of bulimia

is bingeing on one day and starving on the next. The consequences of bulimia are not as severe as anorexia, but they can result in serious mental, gastrointestinal, and dental problems.

### ***Is there an ideal body fat percentage?***

The ideal weight and fat-lean ratio varies considerably for men and women by age. The average healthy adult body fat range regardless of age is **15 to 20 percent for men and 20 to 25 percent for women**. A woman with more than 32 percent body fat and males with more than 25 percent body fat are considered to be at increased risk for disease.

### ***What health effects result from having an extremely low body fat percentage?***

The attempt to reduce body fat by extreme measures not only leads to decreased exercise performance, but it also can lead to severe health complications. Nutrient deficiencies and fluid/electrolyte imbalance from low food intake can lead to increased risk of fractures, illness, loss of reproductive function and serious conditions such as dehydration, and starvation.

### ***How do people manage their body fat?***

The three most important factors to maintain a healthy body fat percentage are:

1. Maintaining your lean muscle mass through routine strength training (minimum 2x/week for each muscle group)
2. Maintaining a healthy well-balanced diet that is low in fat (<30% of calories from fat)
3. Maintaining consistent sleep patterns (minimum 7 hours/night). Always seek the assistance of a medical or health and fitness professional for personal program guidance in reducing or managing your body fat.

## ***4.2. Principles of Exercise Prescription for Health and Fitness***

Doctors often prescribe medications to treat certain diseases, and for every individual there is an appropriate dosage of medicine to cure an illness. Similarly, for each individual, there is a correct dosage of exercise to effectively promote physical fitness, called an exercise prescription. Exercise prescriptions should be tailored to meet the needs of the individual. It should

include fitness goals, mode of exercise, a warm-up, a primary conditioning period, and a cool-down.

#### **4.2.1. Fitness Goals**

Establishing short-term and long-term fitness goals is an important part of an exercise prescription. Goals serve as motivation to start an exercise program. Further, attaining your fitness goals improves self-esteem and provides the incentive needed to make a lifetime commitment to regular exercise.

A logical and common type of fitness goal is a performance goal. You can establish performance goals in each component of health-related physical fitness. Table 4.1 illustrates a hypothetical example of how Mr X might establish short-term and long-term performance goals using fitness testing to determine when she has reached her objective. The column labeled "current status" contains individual's fitness ratings based on tests performed prior to starting his/her exercise program. After consultation with his/her instructor, the individual has established short-term goals that he/she hopes to achieve within the first 8 weeks of training. Note that the short-term goals are not "fixed in stone" and can be modified if the need arises. Susie's long-term goals are fitness levels that she hopes to reach within the first 18 months of training. Similar to short-term goals, long-term goals can be modified to meet changing needs or circumstances.

In addition to performance goals, consider establishing exercise adherence goals. That is, set a goal to exercise a specific number of days per week. Exercise adherence goals are important because fitness will improve only if you exercise regularly! In writing your personal fitness goals, consider the following guidelines:

#### **Set Realistic Goals**

The most important rule in setting goals is that, you must establish realistic ones. After a thorough self-evaluation and consultation with your instructor, set fitness goals that you can reach. Because failure to reach goals is discouraging, establishment of realistic short-term goals is critical to the success of your exercise program.

### ***Establish Short-Term Goals First***

Reaching short-term fitness goals is a great motivation to continue exercising. Therefore, establishment of realistic short-term goals is critical. After reaching a short-term goal, establish a new one.

Table 4.1 Fitness improvement goals

| Fitness category          | Current status | Short term goal | Long term goal |
|---------------------------|----------------|-----------------|----------------|
| Cardiorespiratory fitness | Poor           | Average         | Excellent      |
| Muscular strength         | Poor           | Average         | Excellent      |
| Muscular endurance        | Very poor      | Average         | Good           |
| Flexibility               | Poor           | Average         | Good           |
| Body composition          | High fat       | Moderately high | Optimal        |

### ***Set Realistic Long-Term Goals***

In establishing long-term goals consider your physical limitations. Heredity plays an important role in determining our fitness limits. Therefore, in establishing long-term goals, set goals that are realistic for you and not based on performance scores of other people.

### ***Establish Lifetime Maintenance Goals***

In addition to short-term and long-term goals, consider establishing a fitness maintenance goal. A maintenance goal is established when your fitness goals have been met and your focus becomes remaining physically active and fit.

### ***List Goals in Written Form***

A key to meeting goals is to write them down and put them in a place where you can see them every day. Goals can be forgotten if they are not verifiable in writing. Further, remember that all goals should be periodically

reevaluated and modified if necessary. Just because goals are in writing does not mean that they cannot be changed.

### ***Recognize Obstacles to Achieving Goals***

If you do not make your fitness goals a serious priority; you will keep putting them off until they no longer exist. Once you begin your fitness program, be prepared to make mistakes (e.g., skip workouts and lose motivation) and backslide some (e.g., fitness level declines). This is normal. However, once you realize that you have stopped making progress toward your goals, you must get back on track and start making progress again as soon as you can.

The importance of fitness goals cannot be overemphasized. Goals provide structure and motivation for a personal fitness program.

#### ***4.2.2. Mode of Exercise***

Every exercise prescription includes at least ***one mode*** of exercise that is, a ***specific type of exercise to be performed***. For example, to improve cardio respiratory fitness, you could select from a wide variety of exercise modes, such as running, swimming, or cycling. Key factors to consider when selecting an exercise mode are enjoyment, availability of the activity, and risk of injury.

Physical activities can be classified as being either high impact or low impact based on the amount of stress placed on joints during the activity. Activities that place a large amount of pressure on joints are called high-impact activities, whereas low-impact activities are less stressful" Because of the strong correlation between high-impact modes of exercise and injuries, many fit-ness experts recommend low-impact activities for fitness beginners or for those individuals susceptible to injury (such as participants who are older or overweight). Examples of high-***impact activities*** include ***running, basketball, and high-impact aerobic dance***. Low-***impact activities*** include ***walking, cycling, swimming, and low-impact aerobic dance***.

#### ***4.2.3. Warm-Up***

A warm-up is a brief (5- to 15-minute) period of exercise that precedes the workout. It generally involves light calisthenics or a low-intensity form of the actual mode of exercise and often includes stretching exercises as well. The purpose of a warm-up is to elevate muscle temperature and increase blood

flow to those muscles that will be engaged in the workout. A warm-up can also reduce the strain on the heart imposed by rapidly engaging in heavy exercise and may reduce the risk of muscle and tendon injuries.

#### **4.2.4. Primary Conditioning Period: The Workout Plan**

The major components of the exercise prescription that make up the primary conditioning period are the mode of exercise (described earlier), frequency, intensity, and duration.

- ✚ **The frequency of exercise** is the number of times per week that you intend to exercise. In general, the recommended frequency of exercise to improve most components of health-related physical fitness is three to five times per week.
- ✚ **The intensity of exercise** is the amount of physiological stress or overload placed on the body during the exercise. The method for determining the intensity of exercise varies with the type of exercise performed. For example, because heart rate increases linearly with energy expenditure (effort) during exercise, measurement of **heart rate** has become a standard means of determining exercise intensity during training to improve cardio respiratory fitness. Although heart rate can also be used to gauge exercise intensity during strength training, the number of exercise **repetitions** that can be performed before muscular fatigue occurs is more useful for monitoring stress during weight lifting. For instance, a load that can be lifted only five to eight times before complete muscular fatigue is an example of high-intensity weight lifting. In contrast, a load that can be lifted 50 to 60 times without resulting in muscular fatigue is an illustration of low-intensity weight training.

Finally, stretching muscles beyond their normal lengths improve flexibility. Intensity of stretching is monitored by the **degree of tension or discomfort** felt during the stretch. Low-intensity stretching results in only minor tension (or limited discomfort) on the muscles and tendons. In contrast, high-intensity stretching places great tension or moderate discomfort on the muscle groups being stretched.

- ✚ Another key component of the exercise prescription is the **duration of exercise**, the amount of time invested in performing the primary workout. Note that the duration of exercise does not include the warm-up or cool-down. In general, research has shown that 20 to 30 minutes

per exercise session (performed at least three times per week) is the minimum amount of time required to significantly improve physical fitness.

#### **4.2.5. Cool-Down**

The cool-down (sometimes called a warm-down) is a 5- to 15-minute period of low-intensity exercise that immediately follows the primary conditioning period. For instance, a period of slow walking might be used as a cool-down following a running workout. A cool-down period accomplishes several goals.

- ✚ First, one primary purpose of a cool-down is to allow blood to be returned from the muscles back toward the heart. During exercise, large amounts of blood are pumped to the working muscles. On cessation (stop) of exercise, blood tends to remain in large blood vessels (called pooling) located around the exercised muscles. Failure to redistribute pooled blood after exercise could result in your feeling ***lightheaded or even fainting***. Prevention of blood pooling is best accomplished by low-intensity exercise using those muscles utilized during the workout. Finally, some fitness experts argue that post-exercise muscle soreness may be reduced as a result of a cool-down.
- ✚ Although a cool-down period may not eliminate muscular soreness entirely, it seems possible that the severity of exercise-induced ***muscle soreness may be reduced*** in people who perform a proper cool-down.