4 PHYSICAL FITNESS

OBJECTIVES

After reading the chapter, you should be able to do the following:

- Explain the role physical fitness plays in wellness and disease prevention
- List and describe the health- and skill-related components of physical fitness
- Define the principles of overload, specificity, and progression
- Define and give examples of aerobic and anaerobic exercises
- Determine a target heart rate zone for cardiorespiratory endurance development
- List methods of assessing physical fitness as it relates to the health-related components
- Design and implement a personal fitness program

Physical activity is critical to maintaining a high level of wellness. In fact, without it, achieving true "wellness" is impossible. Physical activity leads to physical fitness, which, in turn, leads to physical wellness. But the benefits of physical activity extend beyond just improving "physical" wellness. All the dimensions of wellness are interrelated; improving any one has beneficial effects on the others. The mind and body work in unison; thus, improving physical wellness leads to a higher level of overall wellness.

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THE IMPORTANCE OF PHYSICAL ACTIVITY

From the very beginning of human existence, man has been an animal on the "move," incorporating many and varied modes of physical activity in all aspects of life. Most eras exhibit widespread physical activity throughout the populace, sometimes in the form of sport, but most often simply in the context of work and providing for the physical needs of the individual and community. In fact, during mankind's early years, highly developed physical fitness was a necessity for survival. As mankind lived in a hunter/gatherer society, achieving high levels of proficiency in hunting skills, such as running and throwing, were valued and actively pursued. But as technology improved, survival depended less on physical activity, and, accordingly, the level of physical activity declined. Today, less than 40 percent of the American population exercises regularly; indeed, 25 percent of the adult population is not active at all.[1] To say that America is a society of "couch potatoes" is not far from the truth.

Physical activity is important at every age, and helps prevent the three leading causes of death–heart disease, cancer, and stroke.

This lack of physical activity in American society is problematic. The leading causes of death today are largely affected by lifestyle behaviors, and a lack of physical activity is a major risk factor for all three.

Exercise provides many benefits. The U.S. Surgeon General[1] reports that regular physical activity does the following:

- *Reduces the risk of dying prematurely*
- *Reduces the risk of dying from heart disease*
- *Reduces the risk of developing diabetes*
- *Reduces the risk of developing high blood pressure*
- *Helps reduce blood pressure in people who already have high blood pressure*
- *Reduces the risk of developing colon cancer*
- *Reduces feelings of depression and anxiety*
- *Helps control weight*
- *Helps build and maintain healthy bones, muscles, and joints*
- *Helps older adults become stronger and better able to move without falling*
- *Promotes psychological well-being*

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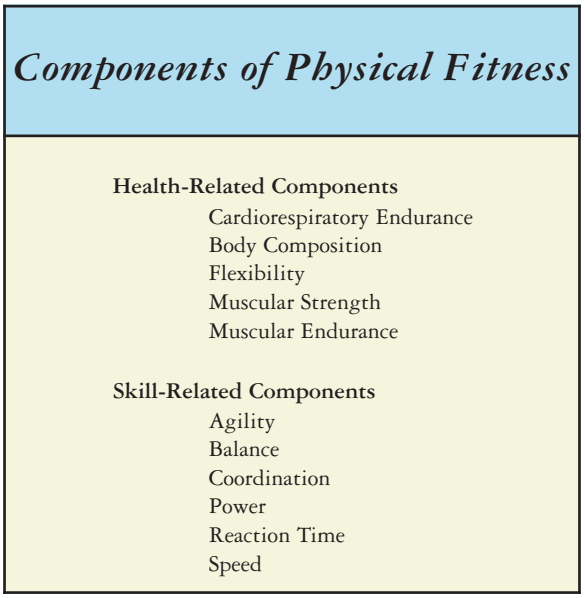
As one can see, physical activity is very beneficial for improving physical fitness and promoting overall wellness. But to fully understand this relationship, it is necessary to examine the elements of physical fitness in detail and understand how physical activity affects each of these.

Figure 4.1



PHYSICAL FITNESS

Simply put, physical fitness is the ability of the body to function optimally without an individual becoming unduly fatigued. Yet physical fitness is also multifaceted, encompassing both health- and skill-related components (See Figure 4.1).

Cardiorespiratory endurance, body composition, flexibility, muscular strength, and muscular endurance comprise the health-related components of physical fitness. Agility, balance, coordination, power, reaction time, and speed are the skill-related components. Both categories play an important role in a person's physical wellness. The health-related components are fundamental to disease prevention and are of primary importance to one's overall wellness. The skill-related components historically are associated more with athletic performance and have been viewed less critical; however, they are important and should not be neglected in an overall physical fitness program.

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HEALTH-RELATED COMPONENTS OF PHYSICAL FITNESS

Cardiorespiratory endurance (CRE). Cardiorespiratory endurance is the ability of the body to oxygenate and fuel the cells of the body, preventing undue fatigue. CRE is simply a measure of how efficient the body is at supplying the exercising muscles with oxygen and fuel and at removing waste products. It can be developed only through physical activity, and plays an important role in the prevention of hypokinetic diseases.

Swimming positively affects all five health-related components of fitness.

Body Composition. Body composition is the amount of body fat compared to fat-free weight (e.g., bones, water, muscles), and is expressed as a percentage of total body weight (e.g., 15% body fat).

Flexibility. Flexibility is defined as the range of motion available at a skeletal joint. It is necessary for efficient movement, and plays an important role in injury prevention. Flexibility also affects one's quality of life, especially as one ages.

Muscular Strength. Muscular strength is the ability of the muscles to exert force against resistance. It is essential in daily living, must be developed to keep the body working properly, and is closely related to muscular endurance.

Muscular Endurance. Muscular endurance is the ability of the muscles to contract repeatedly and to exert force against resistance over a period of time. Muscular endurance determines how long physical exertion can be maintained before excessive fatigue overwhelms the individual.

STUDY TIP:

Cardiorespiratory endurance is simply a measure of how efficient the body is at supplying the exercising muscles with oxygen and fuel and at removing waste products.

SKILL-RELATED COMPONENTS OF PHYSICAL FITNESS

Agility. Agility refers to the ability of a person to be agile, or to move quickly and deliberately with accuracy. It requires a great deal of strength, coordination, balance, and speed.

Balance. Balance is the ability of a person to maintain equilibrium.

Coordination. Coordination involves performing two or more tasks simultaneously, by integrating the senses.

Power. Power technically means work divided by time. It refers to the ability to generate large amounts of force in a short period of time. Strength and speed affect power.

Reaction Time. Reaction time is the period of time that a person requires to react to a specific stimulus. As individuals age, reaction time decreases, often as a result of reduced power.

Speed. Speed is the ability of a person to perform a specific task in a short amount of time.

TERMS FOR PHYSICAL FITNESS

Below are other terms commonly used when discussing physical fitness. Understanding them is critical to understanding physical fitness.

Aerobic. Aerobic means "with oxygen," and refers to physical activities that are usually continuous, rhythmic, and of long duration (e.g., jogging 2 miles).

Anaerobic. The literal definition of anaerobic is "without oxygen." Anaerobic physical activities are usually of high intensity and last for a short period (e.g., sprinting 50 yards at maximum effort).

Cool-Down. The closing segment of a workout is the cool-down. This is the period where an individual gradually stops the exercise bout and returns the body slowly to a resting state. A cool-down is the time when the body is trying to get back to a resting "steady state," and it is the period where lactate is being cleared from the body. A cool-down usually involves light activities and some stretches. One reason for a cool-down is to prevent blood from pooling in the legs, which could cause a person to become dizzy and faint. A cool-down period also helps prevent abnormal heart rhythms from developing, and decreases the muscular stiffness and soreness that can occur after intense exercise.

Cross-Training. Cross-training refers to a training regimen involving more than one type of physical activity. Cross-training is designed to affect each of the five health-related components of physical fitness. An example of cross-training is jogging and swimming regularly, while also performing resistance training.

Exercise Bout. An exercise bout is the actual time engaged in optimal physical activity at the proper intensity (i.e., for cardiorespiratory endurance development, an exercise bout would last for a minimum of 20 minutes).

Hypertrophy. The process of a muscle fiber increasing in size after being overloaded through resistance training is hypertrophy.

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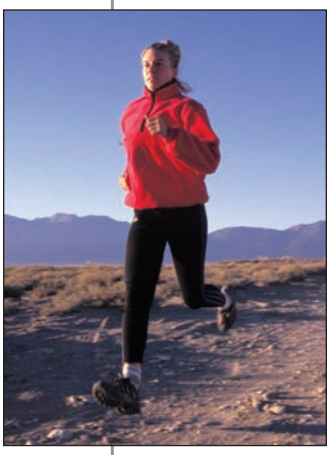

Physical fitness encompasses a combination of activities that result in overall health and wellness.

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Overload. The principle of working the body past the point to which it is normally accustomed is called overload. When the body is overloaded, it must adapt (e.g., muscles grow and become larger, i.e., hypertrophy, after being overloaded). Only through overloading a muscle or body system will improvements be made.

Performing yoga is a wonderful way to increase flexibility.

Progression. Progression is the gradual and slow buildup of a workload. The 10 percent rule should be followed—an individual should increase the workload no more than 10 percent each week (e.g., if someone normally runs for 10 minutes a day, the rule of progression would state that the next week the workload should only increase to 11 minutes). This helps the body adapt better and prevents injuries.

Repetition. A repetition is the number of times a specific movement is performed.

Set. A set is made up of a number of repetitions performed during a pre-determined time-frame.

Specificity. The principle of specificity refers to the fact that only the muscles or systems of the body that are actually worked will adapt and develop. For instance, to increase the muscular strength in the arms, one would not exercise the legs, and vice versa. Specificity also explains why there is a limited carryover from one activity to another (e.g., world-class swimmers are not necessarily world-class runners, and vice versa).

Warm-Up. The warm-up is the first part of a workout, and helps to prevent injuries by properly preparing the body for the upcoming exercise bout. It helps to increase muscular temperature and flexibility by stretching ligaments and tendons. A proper warm-up should include some light walking, jogging, or cycling at minimal effort to "work up a sweat." Usually 3-5 minutes is sufficient. Performing movements that move the joints to be used during the exercise session is paramount. A warm-up increases the range of motion available at a joint, and it helps to lessen the potential for injury. A proper "aerobic" warm-up should be included before any intense exercise is begun.

Workout. A workout involves three distinct and different segments: 1) warm-up; 2) exercise bout; and 3) cool-down.

THE "FITT" PRINCIPLE

The "FITT" Principle

FREQUENCY—How often

INTENSITY—How hard

TIME—How long

TYPE—What kind

The acronym FITT represents the principles of Frequency, Intensity, Time, and Type. Each of these principles must be considered when developing an exercise program.

Recommendations for exercise programs have been developed by the American College of Sports Medicine (ACSM), and are used in this textbook. The ACSM recommends that healthy adults use "a well-rounded training program including aerobic and resistance training, and flexibility exercises" that follow the FITT principle.[2]

Frequency. The "F" in frequency stands for how often someone should exercise, and is expressed as the number of days per week. For CRE development, 3-5 days per week is recommended depending upon the intensity of the physical activity, and 2-3 days per week should be allotted for muscular strength, muscular endurance, and flexibility enhancement. However, research has shown that as little as one, 30-minute weekly bout of eccentric exercise can promote positive health changes (e.g., improved blood-lipid profile).[11] For general health maintenance and promotion, it is recommended that adults accumulate 30 minutes or more of moderate-intensity physical activity on most, if not all, days.[4]

Intensity. The "I" in intensity refers to how hard someone should exercise. For CRE improvements, intensity is easily measured by heart rate. The intensity should be somewhere between 55 and 90 percent of the maximum heart rate (HR_{max})—the absolute number of times the heart can beat in 1 minute—this is known as the target heart rate zone (THZ). The HR_{max} can be estimated by subtracting one's age from 220. Thus, a 20-year old has an estimated HR_{max} of 200 beats per minute. To determine the THZ, simply multiply the HR_{max} by 55 percent and 90 percent. A 20-year old would want to exercise at a heart rate between 110 to 180 beats per minute. The low and high ends are the extremes, and are not the best numbers to strive for—especially the high end. Staying between 120 to 170 beats per minute is probably more realistic. Unfit beginners should aim for the low end of the zone (i.e., 55-64%), especially in the initial weeks. As fitness progresses,

Intensity refers to how hard someone should exercise. As fitness progresses, a higher intensity should be attained.

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a higher intensity (i.e., 65-79%) should be used. The top end of the zone (i.e., 80-90%) should probably be reserved for high-performance athletes.

A less-scientific approach to determine a proper intensity is the "talk test." The "talk test" uses speech to gauge intensity. Basically, if an individual can carry on a conversation without any problems while exercising, the intensity is too low; on the other hand, if someone can barely speak because of heavy breathing, the intensity is probably too high.

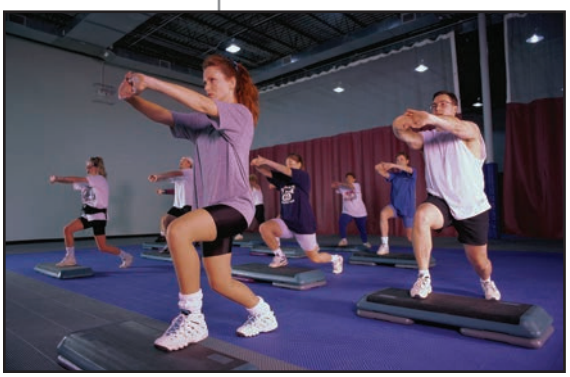
Lastly, an individual could gauge intensity by ratings of perceived exertion (RPE). Dr. Gunnar Borg[5] discovered that individuals could gauge their physical efforts through perception. He developed a scale that begins with 6 and ends with 20. The "6" denotes the physical exertion required to sit, with each number progressively increasing to "20," which represents maximal effort (See Figure 4.2).

The numbers on the RPE scale roughly correspond to exercising heart rates of healthy, young adults (i.e., the 12 and 14 on the scale correspond to 120 and 140 beats per minute, respectively). To use RPE effectively, however, an individual would need to monitor heart rate, while noting RPE. After several weeks, an individual should develop the skill necessary to "perceive" the proper intensity, without having to monitor heart rate as frequently.

To improve muscular strength and muscular endurance, an individual needs to overload the muscle by using resistance training that stimulates the major muscle groups. The intensity should be a weight that can be lifted properly for 8-10 repetitions. By the 10th repetition, the muscle should be approaching complete exhaustion. If it is not, the weight is not heavy enough to properly overload the muscle. If a minimum of 8 repetitions cannot be performed, the weight is too heavy. For older individuals (i.e., 50 years and above), 10-15 repetitions is more feasible.

Time. The "T" is for time, or how long someone should exercise. To optimally develop CRE, an individual should exercise for 20-60 minutes with continuous aerobic activity. (NOTE: Accumulated 10-minute bouts of aerobic exercise are acceptable). For muscular strength and muscular endurance improvements, the time factor is relative to the number of sets performed. One set is recommended, but multiple sets can provide exponentially greater benefits, if the individual so desires. As for stretching, four repetitions for each specific stretch are recommended.

The development of cardiorespiratory endurance is accomplished through aerobic activities.



Type. The second "T" refers to the type, or mode, of activity. Aerobic activities continually use the large muscle groups in a rhythmic nature. Examples of aerobic activities

include the following: jogging, cycling, stair-climbing, and swimming. Activities of this type should be used for CRE improvement.

For muscular strength and muscular endurance development, resistance training, such as lifting weights, should be used. Resistance training should be progressive and individualized for personal goals and fitness level.

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Figure 4.2

Ratings of Perceived Exertion (RPE)

6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

Source: Psychophysical Bases of Perceived Exertion by Borg[5]

Flexibility should be developed using static stretching exercises—stretches that are held at the point of tension, not pain, for an extended period of time up to 60 seconds. . Static stretches are preferred because of their decreased risk of injury and their overall effectiveness. Ballistic, or jerking or bouncing stretches, should be avoided, especially for those just beginning a stretching regime.

DEVELOPING CARDIORESPIRATORY ENDURANCE THROUGH EXERCISE

Physical activity is the only means of developing cardiorespiratory endurance. When individuals exercise, they are strengthening the heart, especially with aerobic activities. As the intensity of the activity increases,

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Sprinting a 100-meter run is an example of anerobic activity because the oxygen demand of the contracting muscles is high, and an individual can only perform the activity for a limited time.

the heart rate rises to match the new workload. Physical activities are aerobic, with oxygen, or anaerobic, without oxygen. An example of an aerobic activity is jogging 2 miles; sprinting a 100-meter run would be an anaerobic activity. The difference is in how the body delivers oxygen to the tissues in relationship to the demand placed upon it. While jogging 2 miles, the body easily can deliver the amount of oxygen and fuel necessary, as long as the individual is properly trained. In fact, if the pace is not too fast, the individual can run for hours. However, when sprinting 100 meters, the oxygen demand of the contracting muscles is much higher, and the individual can only perform this for a limited time, usually no longer than 2 minutes, if highly trained. An easy way to determine if an activity is aerobic or anaerobic is to ask yourself, "Can individuals do this and hold their breath?" If they can, it is likely to be anaerobic. If they cannot, it is probably aerobic.

To fully understand cardiorespiratory endurance, one must break down the word into its parts. "Cardio" is an abbreviation for the cardiovascular system, and deals with the heart, blood, and blood vessels (i.e., arteries, capillaries, and veins). "Respiratory" refers to the respiratory system, and includes the trachea, bronchi, and lungs. The term "endurance" refers to how long the systems can work together efficiently in oxygenating the blood and delivering oxygen and fuel to the contracting muscles, while preventing undue fatigue.

Cardiorespiratory endurance is measured by determining the maximal oxygen consumption (VO_{2max})—the amount of oxygen the body can utilize at its maximal effort. (NOTE: Oxygen consumption is also known as aerobic capacity). VO_{2max} is the scientific symbol used to denote maximum oxygen consumption. The V stands for volume per minute; O_2 is the chemical symbol for oxygen; and max refers to maximum exertion. VO_{2max} is usually expressed in its relative form of milliliters per kilogram of body weight per minute (i.e., ml/kg/min), but it can be expressed in its absolute form of liters per minute (i.e., L/min).

The amount of blood that is ejected from the heart (i.e., the left ventricle) with each beat is called the stroke volume (SV). The average adult at rest ejects approximately 70 ml of blood with each beat. Cardiac output (CO or Q) is the amount of blood the heart pumps in 1 minute. The resting heart rate (HR) is the number of times the heart beats in 1 minute; the average adult's resting heart rate is 75 beats per minute (b/min). To determine Q, the following formula is used:

Q = SV multiplied by HR
= 70 ml multiplied by 75 b/min
= 5,250 ml/min or 5.25 L/min

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What is important to note in this equation is the relationship among Q, SV, and HR. At rest, Q is not going to change. However, as an individual gets in better condition through physical activity, resting HR goes down. In order for this to occur, the SV must have gone up. This concept is easy to understand when one thinks of well-trained endurance athletes like marathon runners. A world-class marathon runner is going to have a resting HR easily in the low 40s, maybe even in the low 30s. Now, compare that to the average adult's resting HR of 75. The Q is going to be relatively the same for the two individuals. What must change in the equation to account for the difference? The SV must increase. The marathoner's heart is much stronger and pumps more blood with each beat. This is the result of physical training involving many hours of training. So, physical training, especially aerobic activities like running, helps make the heart stronger, thus increasing SV and reducing resting HR.

STUDY TIP:

Physical training makes the heart stronger so it can pump more blood with each beat.

TYPES OF TRAINING FOR CARDIORESPIRATORY ENDURANCE

Many different forms of training are available to improve cardiorespiratory endurance. The major types are long slow distance (LSD), fartlek, interval, and circuit training.

Long Slow Distance (LSD) Training. LSD is exactly as its name implies—exercising for long distances at a slow pace. A perfect example of LSD is jogging. LSD is one of the best means of exercising to develop CRE, and it should be used in all training programs. The key to LSD is keeping the exercising HR within the low end of the THZ for a period exceeding 30 minutes. Continuous aerobic activities (e.g., running, swimming, cycling, in-line skating) instead of intermittent activities (e.g., tennis, racquetball, basketball) are the best activities for LSD because the proper HR is easier to sustain in them. However, any activity that increases the HR for an extended time can increase cardiorespiratory endurance.

Fartlek Training. Fartlek is a Swedish term meaning "speed play." It is used primarily by runners in their training programs. In fartlek train-

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ing, an individual runs (or cycles, skis, etc.) at different speeds over a variety of terrain. Basically, an individual puts in surges, while performing LSD training. The strength of this form of training is that it breaks up the monotony of training by varying the speed and difficulty of the training. To be effective in developing cardiorespiratory endurance, fartlek training must keep the HR in the target heart range zone, even occasionally surpassing the upper limit for brief periods of time.

Figure 4.3

American College of Sports Medicine's Recommendations for Exercise

	Cardio-respiratory Endurance	Muscular Strength & Endurance	Flexibility
Frequency	3-5 d/wk	2-3 d/wk	2-3 d/wk
Intensity	55-90% HRmax	8-10 repetitions	4 repetitions to the point of tension, not pain
Time	20-60 minutes	1 set minimum	Hold the stretch for 10-30 seconds
Type	Aerobic Exercises	Resistance Training	Static Stretching

INTERVAL TRAINING. Interval training is the opposite of LSD. Interval training is not continuous; rather, it involves periods of exertion, followed by rest, and is very regimented. The purpose of interval training is to allow an individual to work at higher intensities over longer periods than if the activity were being performed continuously. An example of interval training is running ten 400-meter laps around a track at a specific workload, say 80 percent of HR_{max}, with easy jogging of 1 minute between each lap. This type of workout allows an individual to exercise at a much higher intensity. However, interval training should be reserved for only a few times each

week. Individuals who are not highly trained should probably avoid interval training until their fitness improves.

Circuit Training. Circuit training involves resistance training, such as lifting weights, often on weight machines (e.g., Cybex). The purpose of circuit training is to train with a "circuit" of resistance exercises with little rest between each, so that the exercising HR stays in the THZ. With circuit training, an individual tries to improve muscular strength and muscular endurance, as well as CRE. To perform circuit training successfully, an individual completes one set of 8-10 repetitions on one machine (e.g., bench press) and then immediately proceeds to the next exercise (e.g., leg press) with little or no rest (i.e., <30 seconds rest). The individual then progresses through all the planned activities in the same manner, in a workout lasting longer than 20 minutes. Also, cardiovascular activities can be added between the resistance training exercise bouts, if desired. If performed correctly, circuit training can be a very useful tool in one's exercise regimen, especially for total fitness.

BODY COMPOSITION

Body composition is "the relative percentage of body weight that is fat and fat-free tissue."[6] It is reported as a percentage of body fat (e.g., 18%), and can be measured by both laboratory and field tests.

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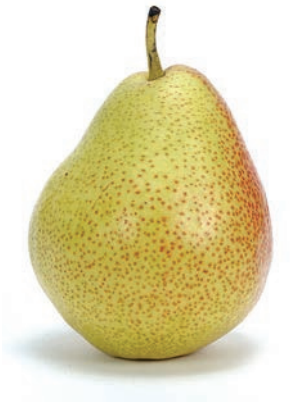
Fat, or adipose tissue, is classified as either essential or nonessential fat. Essential fat is necessary for the body to function properly, and is found within the brain, spinal cord, nerves, and other vital organs. Essential fat is 3 percent in men, 12 percent in women.[7]

Nonessential fat is stored subcutaneously (i.e., directly under the skin) and around the major organs. Men and women store fat differently. Men typically store more fat around their abdomens, eventually developing an "apple" shape when they are obese. Women generally store fat on their upper thighs and hips, producing a "pear" shape; however, some women also store fat on their abdomens and develop the "apple" shape, as well. Fat serves three main purposes in humans: 1) it insulates the body; 2) it stores energy; and 3) it protects the vital organs via padding. However, as stated in Chapter 2, having too much fat, or being obese, is a risk factor for cardiovascular disease and cancer. And the storage site for the excessive fat plays a role in disease, as well. Excessive fat storage around the abdomen increases one's risk for developing CVD.[8] So maintaining proper body composition is important for living a healthy life. Obviously, a certain amount of body fat is necessary. But how much fat is too much?



When storing excessive body fat one typically develops the shape of an apple or a pear. The apple shape is more dangerous from a health perspective, especially with heart disease.

OBESITY

The method of determining obesity has been debated for years. Traditionally, health professionals used height and weight tables developed by insurance companies to define obesity. This method was problematic because some individuals have a greater amount of musculature, making them "overweight," but not "overfat." So instead of focusing on weight to determine obesity, the emphasis has shifted to body composition, specifically what percentage of the body is actually fat.

Figure 4.4

American College of Sports Medicine's Classifications of Body Mass Index (BMI)

	BMI (kg/m2)	Disease Risk
Underweight	<18.5	. . .
Normal	18.5-24.9	. . .
Overweight	25.0-29.9	Increased
Obesity, class		
I	30.0-34.9	High
II	35.0-39.9	Very High
III	>40	Extremely High

Source: ACSM's Guidelines for Exercise Testing and Prescription[6]

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With respect to body fat percentage, obesity (or overfatness) is defined as greater than 20 percent for men and 30 percent for women.[7] Another means of determining body composition is through an indirect method called the Body Mass Index (BMI). The BMI is a mathematical formula that correlates with body composition and disease risk. The BMI is computed by determining the ratio of weight to height squared. A BMI of 30 or more is considered obese, between 25-29.9 is overweight, and less than 18.5 is considered underweight (See Figure 4.4).[6] To quickly determine your BMI, refer to Figure 4.5.

Figure 4.5

Determining the Body Mass Index (BMI)

The BMI is excellent for predicting disease risk. To calculate your BMI, simply look at the chart below and find your height in the left-hand column. Then, go across the row and find the number that corresponds best with your weight, with shoes off. Next, follow up that column to the very top to find your BMI and rating.

BMI	Under Weight <18.5	Healthy Weight 18.5-24.9						Overweight 25-29.9						Obese >29.9 High Disease Risk					
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
Height	Weight in Pounds																		
4'10"	86	91	96	100	105	110	115	119	124	129	134	138	143	148	153	158	162	167	
4'11"	89	94	99	104	109	114	119	124	128	133	138	143	148	153	158	163	168	173	
5'0"	92	97	102	107	112	118	123	128	133	138	143	148	153	158	163	168	174	179	
5'1"	95	100	106	111	116	122	127	132	137	143	148	153	158	164	169	174	180	185	
5'2"	98	104	109	115	120	126	131	136	142	147	153	158	164	169	175	180	186	191	
5'3"	102	107	113	118	124	130	135	141	146	152	158	163	169	175	180	186	191	197	
5'4"	105	110	116	122	128	134	140	145	151	157	163	169	174	180	186	192	197	204	
5'5"	108	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210	
5'6"	112	118	124	130	136	142	148	155	161	167	173	179	186	192	198	204	210	216	

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Figure 4.5 continued

Determining the Body Mass Index (BMI) (Cont'd)

BMI	Under Weight <18.5	Healthy Weight 18.5-24.9						Overweight 25-29.9					Obese >29.9 High Disease Risk					
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Height	Weight in Pounds																	
5'7"	115	121	127	134	140	146	153	159	166	172	178	185	191	198	204	211	217	223
5'8"	118	125	131	138	144	151	158	164	171	177	184	190	197	203	210	216	223	230
5'9"	122	128	135	142	149	155	162	169	176	182	189	196	203	209	216	223	230	236
5'10"	126	132	139	146	153	160	167	174	181	188	195	202	209	216	222	229	236	243
5'11"	129	136	143	150	157	165	172	179	186	193	200	208	215	222	229	236	243	250
6'0"	132	144	151	159	166	174	182	189	197	204	212	219	227	235	242	250	257	265
6'1"	136	144	151	159	166	174	182	189	197	204	212	219	227	235	242	250	257	265
6'2"	141	148	155	163	171	179	186	194	202	210	218	225	233	241	249	256	264	272
6'3"	144	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264	272	279
6'4"	151	160	168	176	185	193	202	210	218	227	235	244	252	261	269	277	286	294
6'5"	151	160	168	176	185	193	202	210	218	227	235	244	252	261	269	277	286	294

Because obesity is a risk factor for the development of hypokinetic disease, especially cardiovascular disease, maintaining proper body composition is very important. Regular physical activity, combined with an appropriate diet, is necessary to maintain proper body composition levels. Body composition maintenance is discussed more fully in Chapter 5, under the sections of nutrition and weight management.

DEVELOPING MUSCULAR STRENGTH AND MUSCULAR ENDURANCE

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The development of both muscular strength and muscular endurance is essential to a well-balanced exercise program. Both of these are health-related components of fitness, and their development is necessary for normal, healthy living. It is important to understand how muscles work in order to maximize the benefits of muscular strength and muscular endurance in an exercise program.

STUDY TIP:

Muscular strength refers to how much force the body's muscles can generate; muscular endurance refers to how long the body's muscles can repeatedly generate that force.

Weight training is effective for developing muscular strength.

Skeletal muscle is capable of contracting via the sliding filament theory.[2] Basically, muscular tissue is made up of small filaments (i.e., actin and myosin) that are able to temporarily attach and slide, overlapping one another, and causing the muscle to both contract and enlarge. Several different forms of muscular contraction occur, and include isometric, isotonic (i.e., concentric and eccentric), and isokinetic.

Isometric Contractions. "Iso" means same; "metric" deals with length. Thus, isometric contractions occur when a muscle contracts and produces tension, yet no movement occurs in the muscle, and it stays the same length. An example of this would be when an individual pushes against a brick wall. The muscles contract producing tension, but they do not shorten or lengthen.

Isotonic Contractions. Isotonic refers to "same tension." There are two types of isotonic contractions: concentric, or a contraction where the muscle shortens (also referred to as the "positive"), and eccentric, a contraction where the muscle lengthens (commonly called the "negative"). A good example of this is when someone lifts a gallon milk jug from the refrigerator and places it on a table. Lifting the jug requires the biceps muscle to contract and shorten—a concentric contraction. Placing the jug on the table requires one to straighten the arm and, thus, lower the jug. This requires a lengthening contraction of the biceps muscle—an eccentric contraction. (An interesting note here is that most muscle soreness is caused by small tears in muscle tissue, not lactic acid build-up as is commonly thought. Interestingly enough, most muscle tearing occurs during eccentric contraction.) Most individuals use isotonic contractions for resistance training.

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Isokinetic Contractions. Isokinetic refers to "same speed." These types of contractions must occur under the governance of a special machine made to control the speed of contraction. These machines are often used for rehabilitative purposes in physician's offices and physical therapy centers. Isokinetic exercises offer the maximum resistance throughout the greatest range of motion, and are probably the most superior form of training. However, they only can be performed with the aid of costly machines and are, thus, not a viable option for most individuals.

To fully develop muscular strength and muscular endurance, an individual must overload the muscle to a higher level than that to which it is accustomed. When the muscle is overloaded, it adapts, becoming larger (i.e., hypertrophy) and stronger. Resistance training should be progressive and conducted consistently for increased gains to result.

DEVELOPING FLEXIBILITY BY STRETCHING

Flexibility is defined as the range of motion about a joint, and is a health-related component of fitness. As individuals age, the muscles and other tissues become less elastic and, thus, flexibility generally decreases. Flexibility's main role in wellness is the prevention of low-back pain (i.e., increasing flexibility in the muscles of the back of the thigh—the "hamstrings"); however, it is very important in maintaining a high quality of life, especially in maintaining independence in older adults. (NOTE: Simple tasks, such as tying one's shoes and reaching into cabinets for food, become very difficult with reduced flexibility.)

Flexibility's main role in wellness is the prevention of low-back pain.

Stretching exercises promote flexibility. Three types of stretches are available for increasing flexibility: static, ballistic, and proprioceptive neuromuscular facilitation (PNF).

Static Stretching. Static stretches involve holding a stretch to the point of tension for a minimum of 10-30 seconds. These are the preferred type of stretches, and are recommended by the ACSM.

Ballistic Stretching. Ballistic stretches involve bouncing throughout a range of motion. Ballistic stretches are considered more advanced, and are typically reserved for highly trained athletes because of an increased risk for injury. They should be avoided by those interested in general fitness. These stretches are problematic in that they activate the muscle's stretch

Regular stretching promotes flexibility.

The use of a partner is often desirable, especially for PNF stretching.

reflex—an automatic response of the muscle that causes it to contract when being stretched to avoid overstretching and tearing.

Proprioceptive Neuromuscular Facilitation (PNF) Stretching. PNF stretches involve alternating muscular contractions with passive stretching. For example, a person would stretch a muscle for a minimum of 10 seconds and then contract the same muscle for a few seconds. This would be followed by the person's partner helping to stretch the muscle that was previously contracted for an extended period. PNF stretches are superior, but difficult to perform without assistance from another trained person; therefore, they are not recommended for general fitness development.

ASSESSING PHYSICAL FITNESS

In order to determine one's level of physical fitness, each health-related component must be assessed. Several tests are available for each component; a few are listed below.

CARDIORESPIRATORY ENDURANCE

Cardiorespiratory endurance development is the cornerstone to physical fitness because of its relationship to the reduction of premature death as the result of disease, especially CVD. The best way to determine cardiorespiratory endurance is by measuring the VO_{2max} in a clinical setting (e.g., graded exercise test on a treadmill, using open-circuit spirometry to analyze O_2 and CO_2 levels). This process is costly, time-consuming, and just not feasible for the general population. Therefore, many field tests have been devel-

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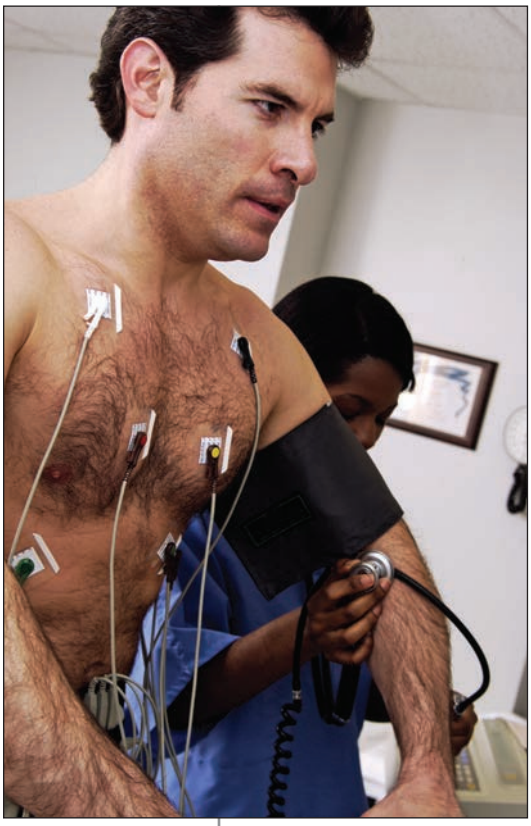

The best way to measure cardiorespiratory endurance is in a clinical setting, but many field tests correlate well with clinical tests.

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oped to estimate VO_{2max} that correlate very well with clinical tests.

Probably the simplest tests to measure cardiorespiratory endurance are the 1.5-Mile Run Test and the 12-Minute Test (NOTE: The Cooper Institute of Dallas, Texas, has developed protocols and fitness norms for these tests, which are cited in this text with its kind permission). These tests are based on the fact that individuals who have high cardiorespiratory endurance development will finish the 1.5-Mile Run faster and will travel farther in the 12-Minute Test than those who are not as fit. The 1.5-Mile Run Test and the 12-Minute Test should be conducted on a properly measured track or another *flat* course, in moderate weather (with little wind, if outside) for best results; irregular surfaces, such as loose gravel, should not be used. An individual should not eat a heavy meal or smoke for at least 2-3 hours prior to the tests. All individuals should perform an appropriate warm-up prior to the tests. If possible, some practice pacing prior to the tests should be employed. Often, individuals run too fast in the beginning of the tests, causing premature fatigue and skewing the results. Proper pacing cannot be underestimated!

For the 1.5-Mile Run Test, do the following:

1. *Warm-up properly with easy exercises, such as walking and jogging. A good stopwatch is recommended to ensure adequate timing of the event.*
2. *Run 1.5 miles as fast as possible; be careful with pacing, and do not start off too fast. (If a standard 400-meter track is used, 6 laps must be run in lane 1 (i.e., the inside lane), with an additional 15 yards added at the end of the last lap. If the track is a 440-yard track, only 6 laps are required in lane 1.*
3. *During the test, participants may be informed of their lap times by a proctor, or they may wear a stopwatch (chronograph).*
4. *Upon completion, the time should be recorded to the nearest second. A mandatory cool-down period should be performed. Participants should walk slowly for about 5 minutes immediately after the run to prevent venous pooling (i.e., pooling of blood in the veins of the lower extremities, which reduces the return of blood to the heart and potentially can cause cardiac arrhythmias).*

The pulse or heart rate can be measured at either the carotid or radial arteries. Be sure to use the fingers and not the thumb to palpate for the pulse.

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To properly perform the 12-Minute Test, follow these procedures:

1. *Warm-up properly with easy exercises, such as walking and jogging, and stretch thoroughly. A good stopwatch is recommended to ensure adequate timing of the event.*
2. *If using a 440-yard track, traffic cones should be placed every 88 yards on the inside edge of lane 1. The first traffic cone is placed at the starting line. If using a 400-meter track, traffic cones should be placed every 80 meters (87.5 yards) on the inside edge of lane 1. In either case, there should be a total of 5 cones placed on the track.*
3. *Cover as much distance as possible in 12 minutes. The number of traffic cones passed during the 12 minutes is then recorded. There are 5 cones per lap completed. Credit is given only for cones passed. If using a 440-yard track, multiply the number of cones passed by .05 to obtain* distance in *miles. If using a 400-meter track, multiply the number of cones passed by .0497 to obtain distance in miles (i.e., on a 440-yard track, John passes 38 cones in 12 minutes; 38 multiplied by .05 = 1.9 miles).*
4. *Upon completion, record the number of cones passed. A mandatory cool-down period, involving walking slowly for about 5 minutes immediately after the run, should be performed to prevent venous pooling (i.e., pooling of blood in the veins of the lower extremities, which reduces the return of blood to the heart and potentially can cause cardiac arrhythmias).*

Walking is one of the simplest activities to perform for developing cardiorespiratory endurance.

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Figure 4.6

Ratings for the 1.5-Mile Run for Women (Time)

	AGE						
Percentile	20-29	30-39	40-49	50-59	60-69	70-79	Rating
99	9:30	9:58	10:09	11:20	12:24	12:24	
95	10:28	11:00	11:33	12:53	14:05	14:21	Superior
90	11:10	11:33	12:11	13:40	14:53	16:40	
85	11:33	11:58	12:53	14:24	15:45	16:46	
80	11:58	12:24	13:23	14:34	16:33	17:51	Excellent
75	12:24	12:53	13:45	15:13	16:46	18:21	
70	12:51	13:24	13:58	15:43	17:30	18:37	
65	12:53	13:47	14:34	16:13	17:38	18:37	
60	13:24	14:08	14:53	16:35	18:27	19:36	Good
55	13:48	14:28	15:13	16:46	18:37	19:43	
50	14:04	14:34	15:34	17:19	19:04	20:02	
45	14:34	15:14	15:58	17:38	19:35	20:52	
40	14:50	15:43	16:31	18:18	20:16	21:31	Fair
35	15:14	15:58	16:46	18:37	20:52	22:07	
30	15:46	16:42	17:29	19:10	21:36	22:46	
25	16:21	16:56	18:05	19:43	22:21	23:20	
20	16:46	17:38	18:37	20:44	22:52	24:06	Poor
15	17:38	18:37	19:35	21:38	23:57	25:49	
10	18:33	19:43	20:52	22:52	24:48	26:51	
5	20:03	21:34	22:22	24:46	26:19	30:00	
1	23:58	24:56	25:59	29:09	30:12	36:13	Very Poor

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

Figure 4.7

Ratings for the 1.5-Mile Run for Men (Time)

	AGE						
Percentil	20-29	30-39	40-49	50-59	60-69	70-79	Rating
99	8:29	8:49	9:10	9:34	10:09	10:28	
95	9:17	9:33	9:51	10:37	11:26	11:58	Superior
90	9:34	10:01	10:28	11:10	12:20	13:24	
85	10:00	10:24	10:48	11:45	12:53	13:58	
80	10:09	10:46	11:15	12:08	13:23	14:34	Excellent
75	10:43	11:06	11:40	12:36	13:52	15:14	
70	10:59	11:22	11:58	12:53	14:16	15:54	
65	11:10	11:33	12:11	13:20	14:34	16:19	
60	11:29	11:54	12:24	13:35	15:04	16:43	Good
55	11:41	11:58	12:53	13:58	15:23	17:12	
50	11:58	12:24	13:12	14:23	15:56	17:38	
45	12:20	12:50	13:24	14:34	16:21	18:11	
40	12:38	12:58	13:50	15:06	16:46	18:38	Fair
35	12:53	13:24	14:11	15:26	17:11	19:24	
30	13:15	13:44	14:34	15:58	17:41	19:43	
25	13:36	14:05	14:53	16:28	18:33	20:36	
20	14:00	14:34	15:24	16:58	19:10	21:47	Poor
15	14:34	15:13	15:58	17:38	20:19	22:52	
10	15:30	15:57	16:46	18:37	21:51	24:49	
5	17:04	17:25	18:48	20:38	24:03	27:58	
1	20:58	20:58	22:22	25:00	29:47	32:46	Very Poor

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

Another simple test for assessing cardiorespiratory endurance is the Step Test. The Step Test is easy to conduct, does not require expensive equipment, and is safe to be performed by most individuals, regardless of their fitness levels. (NOTE: Individuals who have high blood pressure—i.e., >140/90 mm HG—orthopedic, respiratory, or cardiac problems should not perform the Step Test.)

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Figure 4.8

Ratings for the 12-Minute Run for Women (Distance in Miles)							
	AGE						
Percentile	20-29	30-39	40-49	50-59	60-69	70-79	Rating
99	1.83	1.76	1.73	1.59	1.49	1.49	
95	1.69	1.63	1.57	1.45	1.36	1.35	Superior
90	1.61	1.57	1.51	1.39	1.31	1.22	
85	1.57	1.53	1.45	1.34	1.26	1.21	
80	1.53	1.49	1.41	1.33	1.22	1.16	Excellent
75	1.49	1.45	1.39	1.29	1.21	1.14	
70	1.46	1.41	1.37	1.27	1.18	1.13	
65	1.45	1.38	1.33	1.24	1.17	1.13	
60	1.41	1.36	1.31	1.22	1.14	1.10	Good
55	1.38	1.34	1.29	1.21	1.13	1.09	
50	1.37	1.33	1.27	1.19	1.12	1.08	
45	1.33	1.29	1.25	1.17	1.10	1.05	
40	1.32	1.27	1.22	1.14	1.07	1.03	Fair
35	1.29	1.25	1.21	1.13	1.05	1.02	
30	1.26	1.21	1.18	1.11	1.03	1.00	
25	1.23	1.20	1.15	1.09	1.01	0.99	
20	1.21	1.17	1.13	1.06	1.00	0.97	Poor
15	1.17	1.13	1.10	1.03	0.98	0.93	
10	1.13	1.09	1.05	1.00	0.95	0.91	
5	1.08	1.03	1.01	0.95	0.92	0.86	
1	0.97	0.95	0.93	0.87	0.86	0.78	Very Poor

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

To perform the Step Test, do the following:

1. *Use a 12-inch bench or step.*
2. *Warm-up with some modest walking or jogging.*
3. *Step up and down on the bench at a cadence of 96 beats per minute—this can be established by using a metronome or a tape recording of a metronome—for 3 minutes. The cadence is "up-up-down-down" or "right-left-right-left."*

Figure 4.9

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Ratings for the 12-Minute Run for Men (Distance in Miles)							
	AGE						
Percentile	20-29	30-39	40-49	50-59	60-69	70-79	Rating
99	2.00	1.94	1.87	1.81	1.73	1.69	
95	1.86	1.82	1.77	1.68	1.59	1.53	Superior
90	1.81	1.75	1.69	1.61	1.50	1.41	
85	1.75	1.70	1.65	1.55	1.45	1.37	
80	1.73	1.66	1.60	1.52	1.41	1.33	Excellent
75	1.66	1.62	1.56	1.48	1.38	1.29	
70	1.63	1.59	1.53	1.45	1.35	1.26	
65	1.61	1.57	1.51	1.42	1.33	1.23	
60	1.58	1.54	1.49	1.40	1.30	1.21	Good
55	1.56	1.53	1.45	1.37	1.28	1.19	
50	1.53	1.49	1.43	1.34	1.25	1.17	
45	1.50	1.46	1.41	1.33	1.23	1.15	
40	1.47	1.44	1.38	1.30	1.21	1.13	Fair
35	1.45	1.41	1.36	1.28	1.19	1.10	
30	1.42	1.39	1.33	1.25	1.17	1.09	
25	1.40	1.36	1.31	1.23	1.13	1.06	
20	1.37	1.33	1.28	1.20	1.11	1.03	Poor
15	1.33	1.29	1.25	1.17	1.07	1.00	
10	1.28	1.25	1.21	1.13	1.03	0.95	
5	1.20	1.18	1.13	1.06	0.97	0.89	
1	1.05	1.05	1.01	0.95	0.86	0.82	Very Poor

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

When stepping up on the bench, it is imperative that you straighten your legs fully so that a proper assessment of cardiorespiratory endurance is taken. (NOTE: It is perfectly acceptable and recommended to switch lead-off legs during the test to prevent unnecessary muscular fatigue in the legs—from "right-left-right-left" to "left-right-left-right.")

4. *After 3 minutes of stepping, stop, sit down on the bench, and find the pulse rate (this can be taken either at the carotid artery in the neck, or at the radi-*

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al artery in the wrist). After 5 seconds of sitting, count the pulse rate for 60 seconds.

5. *Record the pulse rate as beats per minute.*
6. *Cool-down by walking for a few minutes to return the heart rate back to normal and prevent pooling of blood in the lower extremities.*
7. *Look at the ratings for the 3-Minute Step Test to see how you rate (Figure 4.10). If you could not finish the test because of fatigue, you probably have very poor cardiorespiratory endurance.*

Figure 4.10

Ratings for the 3-Minute Step Test

	Women	Men
Excellent	<97	<71
Good	97-127	71-102
Average	128-142	103-117
Poor	143-171	118-147
Very Poor	>172	>148

Numbers represent heart rate reported as beats per minute.

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission

ASSESSING BODY COMPOSITION

Many methods are available to measure body composition, especially as it relates to disease risk. The easiest methods are determining the Waist-to-Hip Ratio and the Body Mass Index (BMI).

The Waist-to-Hip Ratio is important because of the link between excessive abdominal fat and the "increased risk of hypertension . . . coronary artery disease, and premature death compared with individuals who are equally fat, but have more of their fat on the extremities."[5] Determining the Waist-to-Hip Ratio is simple. All that is necessary is a tape measure. An individual measures the circumferences of both the waist and hips. Then a ratio is computed by taking the circumference of the waist divided by the circumference of the hips. Risk factors for Waist-to-Hip Ratio are located in Figure 4.11. The ACSM states that "the waist circumference can be used alone as an indicator of health risk because abdominal obesity is the issue."[5]

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Figure 4.11

Waist-to-Hip Ratio Health Risk

	Women	Men
High Health Risk	>.85	>1.0
Moderate Health Risk	.80-.85	.90-1.0
Low Health Risk	<.80	<.90

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

A waist circumference of greater than 100 centimeters (i.e., approximately 39 inches) for either men or women is considered an index for obesity, and places a person at an increased risk of disease.

Calculating the Body Mass Index (BMI) is a simple mathematical formula wherein the weight (in kilograms [kg]) is divided by the height (in meters [m]) squared (i.e., BMI = kg/m^2). A BMI between 18.5-24.9 is normal; 25-29.9 is "overweight," and could potentially cause health problems; "obesity" is defined as a BMI greater than 30 (See Figure 4.5).[5] Using the BMI to determine body fat percentage has a large margin of error; therefore, the ACSM states, "[BMI] should not be used to determine an individual's body fatness during a fitness assessment."[5] Thus, the BMI is a gauge to assess disease risk, not body fat percentage per se. A better means of assessing actual body fat percentage is with skinfold measurements, hydrostatic weighing, or bioelectrical impedance.

The Waist-to-Hip Ratio is computed by taking the circumference of the waist and dividing it by the circumference of the hips.

Assessing body fat percentage through skinfolds correlates well with the more-advanced method of hydrostatic weighing (i.e., a process wherein a person's body is submerged in water and weighed to determine exact body volume, based on the principle of mass displacement. It is accurate, but very time-consuming, and used mainly for research purposes). Skinfold measurements assume that individuals store fat subcutaneously proportional to total body fat. If the proper techniques are used, skinfolds can be within 3.5 percent of accuracy as compared to hydrostatic weighing.[6] It is best to remember skinfolds are an estimate of body fat percentage, and a margin of error is always involved.

To measure body composition accurately using skinfolds, an individual would need to work with a person who is properly trained; then they would follow these steps:

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1. *Measure the right side of the body, and use the appropriate sex-based sites.*

WOMEN

Triceps—vertical fold midway between the shoulder and elbow, technically the acromion process and the olecranon process, respectively.
Suprailiac—a diagonal fold above the iliac crest (i.e., hip bone).
Thigh—a vertical fold taken midway from the iliac crest (i.e., hip bone) and the patella (i.e., kneecap).

MEN

Chest—a diagonal fold taken midway from the nipple and armpit.
Abdomen—a vertical fold taken approximately 1 inch from the navel.
Thigh—a vertical fold taken midway from the iliac crest (i.e., hip bone) and the patella (i.e., kneecap).

2. *Pinch the skinfold using the thumb and the forefinger, and place the caliper perpendicular to the skinfold, about 1/4-inch below the fingers.*
3. *Measure at least twice, or until you get numbers that agree or are within 1 mm.*
4. *Sum the 3 skinfolds, and look at Figure 4.12 or 4.13 to ascertain your estimated percent body fat.*
5. *Determine your rating for body composition by using Figures 4.14 or 4.15.*

ASSESSING FLEXIBILITY

A variety of field tests can measure flexibility. The most popular of these is the Sit-and-Reach Test. This test measures flexibility in the hamstrings. (NOTE: Flexibility in the hamstrings is important because of its relationship to low back pain, the number one cause of chronic pain in adults.) The test is typically performed with the aid of a special box and ruler to measure the exact amount of flexibility in the hamstrings and lower back. However, a modification of the Sit-and-Reach Test is the Sit-and-Reach Wall Test.

The Sit-and-Reach Wall Test measures flexibility in the hamstrings, and is easy to administer; all that is needed is a person and a wall.

Figure 4.12

Body Fat Percentage Estimates for Women

Sum of 3 Skinfolds	<22	23-27	28-32	33-37	38-42	43-47	48-52	53-57	>58
23-25	9.7	9.9	10.2	10.4	10.7	10.9	11.2	11.4	11.7
26-28	11.0	11.2	11.5	11.7	12.0	12.3	12.5	12.7	13.0
29-31	12.3	12.5	12.8	13.0	13.3	13.5	13.8	14.0	14.3
32-34	13.6	13.8	14.0	14.3	14.5	14.8	15.0	15.3	15.5
35-37	14.8	15.0	15.3	15.5	15.8	16.0	16.3	16.5	16.8
38-40	16.0	16.3	16.5	16.7	17.0	17.2	17.5	17.7	18.0
41-43	17.2	17.4	17.7	17.9	18.2	18.4	18.7	18.9	19.2
44-46	18.3	18.6	18.8	19.1	19.3	19.6	19.8	20.1	20.3
47-49	19.5	19.7	20.0	20.2	20.5	20.7	21.0	21.2	21.5
50-52	20.6	20.8	21.1	21.3	21.6	21.8	22.1	22.3	22.6
53-55	21.7	21.9	22.1	22.4	22.6	22.9	23.1	23.4	23.6
56-58	22.7	23.0	23.2	23.4	23.7	23.9	24.2	24.4	24.7
59-61	23.7	24.0	24.2	24.5	24.7	25.0	25.2	25.5	25.7
62-64	24.7	25.0	25.2	25.5	25.7	26.0	26.2	26.4	26.7
65-67	25.7	25.9	26.2	26.4	26.7	26.9	27.2	27.4	27.7
68-70	26.6	26.9	27.1	27.4	27.6	27.9	28.1	28.4	28.6
71-73	27.5	27.8	28.0	28.3	28.5	28.8	29.0	29.3	29.5
74-76	28.4	28.7	28.9	29.2	29.4	29.7	29.9	30.2	30.4
77-79	29.3	29.5	29.8	30.0	30.3	30.5	30.8	31.0	31.3
80-82	30.1	30.4	30.6	30.9	31.1	31.4	31.6	31.9	32.1
83-85	30.9	31.2	31.4	31.7	31.9	32.2	32.4	32.7	32.9
86-88	31.7	32.0	32.2	32.5	32.7	32.9	33.2	33.4	33.7
89-91	32.5	32.7	33.0	33.2	33.5	33.7	33.9	34.2	34.4
91-94	33.2	33.4	33.7	33.9	34.2	34.4	34.7	34.9	35.2
95-97	33.9	34.1	34.4	34.6	34.9	35.1	35.4	35.6	35.9
98-100	34.6	34.8	35.1	35.3	35.5	35.8	36.0	36.3	36.5
101-103	35.2	35.4	35.7	35.9	36.2	36.4	36.7	36.9	37.2
104-106	35.8	36.1	36.3	36.6	36.8	37.1	37.3	37.5	37.8
107-109	36.4	36.7	36.9	37.1	37.4	37.6	37.9	38.1	38.4
110-112	37.0	37.2	37.5	37.7	38.0	38.2	38.5	38.7	38.9
113-115	37.5	37.8	38.0	38.2	38.5	38.7	39.0	39.2	39.5
116-118	38.0	38.3	38.5	38.8	39.0	39.3	39.5	39.7	40.0
119-121	38.5	38.7	39.0	39.2	39.5	39.7	40.0	40.2	40.5
122-124	39.0	39.2	39.4	39.7	39.9	40.2	40.4	40.7	40.9
125-127	39.4	39.6	39.9	40.1	40.4	40.6	40.9	41.1	41.4

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

Figure 4.13

Body Fat Percentage Estimates for Men (52 and Under)

Sum of 3 Skinfolds	< 20	20-22	23-25	26-28	29-31	32-34	35-37	38-40	41-43	44-46	47-49	50-52
11-13	1.9	2.3	2.6	3.0	3.3	3.7	4.0	4.3	4.7	5.0	5.4	5.7
14-16	2.9	3.3	3.6	3.9	4.3	4.6	5.0	5.3	5.7	6.0	6.4	6.7
17-19	3.9	4.2	4.6	4.9	5.3	5.6	6.0	6.3	6.7	7.0	7.4	7.7
20-22	4.8	5.2	5.5	5.9	6.2	6.6	6.7	7.3	7.6	8.0	8.3	8.7
23-25	5.8	6.2	6.5	6.8	7.2	7.5	7.9	8.2	8.6	8.9	9.3	9.6
26-28	6.8	7.1	7.5	7.8	8.1	8.5	8.8	9.2	9.5	9.9	10.2	10.6
29-31	7.7	8.0	8.4	8.7	9.1	9.4	9.8	10.1	10.5	10.8	11.2	11.5
32-34	8.6	9.0	9.3	9.7	10.0	10.4	10.7	11.1	11.4	11.8	12.1	12.4
35-37	9.5	9.9	10.2	10.6	10.9	11.3	11.6	12.0	12.3	12.7	13.0	13.4
38-40	10.5	10.8	11.2	11.5	11.8	12.2	12.5	12.9	13.2	13.6	13.9	14.3
41-43	11.4	11.7	12.1	12.4	12.7	13.1	13.4	13.8	14.1	14.5	14.8	15.2
44-46	12.2	12.6	12.9	13.3	13.6	14.0	14.3	14.7	15.0	15.4	15.7	16.1
47-49	13.1	13.5	13.8	14.2	14.5	14.9	15.2	15.5	15.9	16.2	16.6	16.9
50-52	14.0	14.3	14.7	15.0	15.4	15.7	16.1	16.4	16.8	17.1	17.5	17.8
53-55	14.8	15.2	15.5	15.9	16.2	16.6	16.9	17.3	17.6	18.0	18.3	18.7
56-58	15.7	16.0	16.4	16.7	17.1	17.4	17.8	18.1	18.5	18.8	19.2	19.5
59-61	16.5	16.9	17.2	17.6	17.9	18.3	18.6	19.0	19.3	19.7	20.0	20.4
62-64	17.4	17.7	18.1	18.4	18.8	19.1	19.4	19.8	20.1	20.5	20.8	21.2
65-67	18.2	18.5	18.9	19.2	19.6	19.9	20.3	20.6	21.0	21.3	21.7	22.0
68-70	19.0	19.3	19.7	20.0	20.4	20.7	21.1	21.4	21.8	22.1	22.5	22.8
71-73	19.8	20.1	20.5	20.8	21.2	21.5	21.9	22.2	22.6	22.9	23.3	23.6
74-76	20.6	20.9	21.3	21.6	22.0	22.3	22.7	23.0	23.4	23.7	24.1	24.4
77-79	21.4	21.7	22.1	22.4	22.8	23.1	23.4	23.8	24.1	24.5	24.8	25.2
80-82	22.1	22.5	22.8	23.2	23.5	23.9	24.2	24.6	24.9	25.3	25.6	26.0
83-85	22.9	23.2	23.6	23.9	24.3	24.6	25.0	25.3	25.7	26.0	26.4	26.7
86-88	23.6	24.0	24.3	24.7	25.0	25.4	25.7	26.1	26.4	26.8	27.1	27.5
89-91	24.4	24.7	25.1	25.4	25.8	26.1	26.5	26.8	27.2	27.5	27.9	28.2
92-94	25.1	25.5	25.8	26.2	26.5	26.9	27.2	27.5	27.9	28.2	28.6	28.9
95-97	25.8	26.2	26.5	26.9	27.2	27.6	27.9	28.3	28.6	29.0	29.3	29.7
98-100	26.6	26.9	27.3	27.6	27.9	28.3	28.6	29.0	29.3	29.7	30.0	30.4
101-103	27.3	27.6	28.0	28.3	28.6	29.0	29.3	29.7	30.0	30.4	30.7	31.1
104-106	27.9	28.3	28.6	29.0	29.3	29.7	30.0	30.4	30.7	31.1	31.4	31.8
107-109	28.6	29.0	29.3	29.7	30.0	30.4	30.7	31.1	31.4	31.8	32.1	32.4
110-112	29.3	29.6	30.0	30.3	30.7	31.0	31.4	31.7	32.1	32.4	32.8	33.1

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

The Sit-and-Reach Wall Test is a self-administered test that can accommodate a large number of individuals because of its simplicity. All that is needed is a person and a wall.

To perform the Sit-and-Reach Wall Test, do the following:

1. *Warm-up by walking or jogging for a few minutes.*
2. *Perform some static stretching (e.g., modified hurdler's stretch). (NOTE: Avoid ballistic stretching because of the increased risk of injury.)*

Figure 4.14

Ratings for Body Composition for Women

AGE					
Percentile	20-29	30-39	40-49	50-59	Rating
99	11.4	11.2	12.1	13.9	Very Lean*
95	14.0	13.9	15.2	16.9	
90	15.1	15.5	16.8	19.1	Excellent
85	16.1	16.5	18.3	20.8	
80	16.8	17.5	19.5	22.3	
75	17.6	18.3	20.6	23.6	Good
70	18.4	19.2	21.7	24.8	
65	19.0	20.1	22.7	25.8	
60	19.8	21.0	23.7	26.7	
55	20.6	22.0	24.6	27.6	Fair
50	21.5	22.8	25.5	28.4	
45	22.2	23.7	26.4	29.3	
40	23.4	24.8	27.5	30.1	
35	24.2	25.8	28.4	30.8	Poor
30	25.5	26.9	29.5	31.8	
25	26.7	28.1	30.7	32.9	
20	28.2	29.6	31.9	33.9	
15	30.5	31.5	33.4	35.0	Very Poor
10	33.5	33.6	35.1	36.1	

**No less than 10-13% is recommended for women, 3% for men.*
Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

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3. *Remove shoes.*
4. *Face the wall and sit down.*
5. *Place the feet flat against the wall, no more than 8 inches apart.*
6. *Point the toes upward toward the ceiling.*
7. *Reach forward, exhaling and keeping the legs straight, and try to touch the wall with either the fingertips, the knuckles, or the palms of the hands.*

Figure 4.15

Ratings for Body Composition for Men

	AGE				
Percentile	20-29	30-39	40-49	50-59	Rating
99	04.2	07.3	09.5	11.0	Very Lean*
95	06.4	10.3	12.9	14.8	
90	07.9	12.4	15.0	17.0	Excellent
85	09.1	13.7	16.4	18.3	
80	10.5	14.9	17.5	19.4	
75	11.5	15.9	18.5	20.2	Good
70	12.6	16.8	19.3	21.0	
65	13.8	17.7	20.1	21.7	
60	14.8	18.4	20.8	22.3	
55	15.8	19.2	21.4	23.0	Fair
50	16.6	20.0	22.1	23.6	
45	17.5	20.7	22.8	24.2	
40	18.6	21.6	23.5	24.9	
35	19.7	22.4	24.2	25.6	Poor
30	20.7	23.2	24.9	26.3	
25	22.0	24.1	25.7	27.1	
20	23.3	25.1	26.6	28.1	
15	24.9	26.4	27.8	19.2	Very Poor
10	26.6	27.8	29.2	30.6	

**No less than 10-13% is recommended for women, 3% for men.*
Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

8. *Keep the hands together and reach as far as possible.*
9. *Hold the touch for at least 3 seconds, being sure to maintain contact with the wall.*
10. *Perform 3 trials, and record the best effort.*
11. *Look at the ratings provided in Figure 4.16 to see how you rate.*

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Figure 4.16

Ratings for the Sit-and-Reach Wall Test

Excellent	Can palm the wall.
Good	Knuckles can touch the wall.
Average	Fingertips can touch the wall.
Poor	Cannot touch the wall.

ASSESSING MUSCULAR ENDURANCE

One of the most widely used tests for measuring muscular endurance is the Sit-up Test. It is an easy and simple test in that a person simply performs as many sit-ups as possible in 1 minute. The key to getting accurate results, however, lies in the fact that the sit-ups must be performed in accordance with the prescribed protocol.

To perform the Sit-up Test, do the following:

1. *Secure a mat or padded area for the test.*
2. *Lie down on the test area in a supine position (on your back).*
3. *Bend the knees and place the heels flat on the floor, with the hands cupped behind the ears.*
4. *Have a partner hold the feet down firmly.*
5. *Perform as many correct sit-ups as possible in 1 minute.*
6. *To perform a sit-up correctly, in the "up" position, one should touch the elbows to the knees, and then return until the shoulder blades touch the floor.*
7. *The score is the total number of correct sit-ups performed in 1 minute (any resting should be done in the "up" position.*
8. *Breathing should be as normal as possible, making sure not to hold one's breath during the test.*
9. *The neck should remain in the neutral position.*
10. *Do NOT pull on the head or the neck.*
11. *Check your ratings in Figure 4.17 or 4.18.*

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FIGURE 4.17

Ratings for the One-Minute Sit-Up Test (Women)

	Age						
Percentil	<20	20-29	30-39	40-49	50-59	60+	Rating
99	56.0+	52.0+	43.0+	39.0+	31.0+	29.0+	Superior
95	55.0	51.0	42.0	38.0	30.0	28.0	
90	54.0	49.0	40.0	34.0	29.0	26.0	
85	49.0	45.0	38.0	32.0	25.0	20.0	
80	46.0	44.0	35.0	29.0	24.0	17.0	Excellent
75	40.0	42.0	33.0	28.0	22.0	15.0	
70	38.0	41.0	32.0	27.0	22.0	12.0	
65	37.0	39.0	30.0	25.0	21.0	12.0	
60	36.0	38.0	29.0	24.0	20.0	11.0	Good
55	35.0	37.0	28.0	23.0	19.0	10.0	
50	34.0	35.0	27.0	23.0	17.0	8.0	
45	34.0	34.0	26.0	21.0	16.0	8.0	
40	32.0	32.0	25.0	20.0	14.0	6.0	Fair
35	30.0	31.0	24.0	19.0	12.0	5.0	
30	29.0	30.0	22.0	17.0	12.0	4.0	
25	29.0	28.0	21.0	16.0	11.0	4.0	Poor
20	28.0	24.0	20.0	14.0	10.0	3.0	
15	27.0	23.0	18.0	13.0	7.0	2.0	
10	25.0	21.0	15.0	10.0	6.0	1.0	Very Poor
5	25.0	18.0	11.0	7.0	5.0	0.0	
1	<25.0	<18.0	<11.0	>7.0	>5.0	0.0	

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

ASSESSING MUSCULAR STRENGTH

Several methods are available to measure muscular strength. The easiest of these is the measurement of hand strength by a grip dynamometer. The reason for measuring hand strength is that it is fast, efficient, extremely safe, and correlates rather highly to strength in other muscles throughout the body.[10]

FIGURE 4.18

Ratings for the One-Minute Sit-Up Test (Men)

	Age						
Percentile	<20	20-29	30-39	40-49	50-59	60+	Rating
99	63.0+	56.0+	52.0+	48.0+	44.0+	40.0+	Superior
95	62.0	55.0	51.0	47.0	43.0	39.0	
90	55.0	52.0	48.0	43.0	39.0	35.0	
85	53.0	49.0	45.0	40.0	36.0	31.0	
80	51.0	47.0	43.0	39.0	35.0	30.0	Excellent
75	50.0	46.0	42.0	37.0	33.0	28.0	
70	48.0	45.0	41.0	36.0	31.0	26.0	
65	48.0	44.0	40.0	35.0	30.0	24.0	
60	47.0	42.0	39.0	34.0	28.0	22.0	Good
55	46.0	41.0	37.0	32.0	27.0	21.0	
50	45.0	40.0	36.0	31.0	26.0	20.0	
45	42.0	39.0	36.0	30.0	25.0	19.0	
40	41.0	38.0	35.0	29.0	24.0	19.0	Fair
35	39.0	37.0	33.0	28.0	22.0	18.0	
30	38.0	35.0	32.0	27.0	21.0	17.0	
25	37.0	35.0	31.0	26.0	20.0	16.0	Poor
20	36.0	33.0	30.0	24.0	19.0	15.0	
15	34.0	32.0	28.0	22.0	17.0	13.0	
10	33.0	30.0	26.0	22.0	15.0	10.0	Very Poor
5	27.0	27.0	23.0	17.0	12.0	7.0	
1	<27.0	<27.0	<23.0	>17.0	>12.0	>7.0	

Source: The Physical Fitness Specialist Manual, The Cooper Institute, Dallas, Texas. Reprinted with permission.

To test for hand strength using a grip dynamometer, follow these procedures:

1. *The person being tested should be standing, looking forward.*
2. *The dynamometer should be adjusted so that the person's second phalanx is at a right angle.*
3. *The forearm should be placed at any angle between 90 and 180 degrees of the upper arm.*

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4. *The upper arm should be placed in a vertical position.*
5. *The person should exert maximally and quickly, while bringing the arm down.*
6. *Two to three trials should be performed alternatively between hands. (NOTE: A rest period of 30 seconds is needed between trials for the same hand to get accurate data.)*
7. *The scores should be recorded and compared to the ratings in Figure 4.19.*

Figure 4.19

Ratings for Dominant Hand Strength (kg)

	Women	Men
Super	>40.0	>65.5
Excellent	36.5	60.0
Good	32.5	55.0
Average	29.0	48.5
Fair	25.0	44.0
Poor	21.5	38.0
Very Poor	>21.0	>38.0

Source: Physical Fitness: A Way of Life by Getchell[10]

SUMMARY

Physical activity is necessary in order to achieve physical fitness and high-level wellness. Physical fitness encompasses both skill- and health-related components (i.e., cardiorespiratory endurance, body composition, flexibility, and muscular strength and endurance), and each of these needs to be developed, especially the health-related components via the FITT principle (i.e., Frequency, Intensity, Time, and Type). The ACSM provides specific recommendations for developing optimal fitness. In summary, to ensure one's health for longevity and disease prevention, the ACSM and the Centers for Disease Control and Prevention believe that "every U.S. adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week."[4]

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CHECK YOUR UNDERSTANDING

REVIEW QUESTIONS

1. What role does physical fitness play in disease prevention?
2. What are the five health-related components of physical fitness?
3. What are the six skill-related components of physical fitness?
4. What role do overload, specificity, and progression play in physical fitness?
5. How do aerobic and anaerobic activities differ?
6. How does one determine the target heart rate zone for developing cardiorespiratory endurance?
7. How can someone assess the five health-related components of physical fitness?

RELATED WEBSITES

American College of Sports Medicine
www.acsm.org

American Heart Association—Just Move
www.justmove.org

National Association for Health and Fitness
www.physicalfitness.org

National Center on Physical Activity and Disability
www.ncpad.org

Sports Science
Sportsci.org

Participation in the combative sports provides for overall physical development.