Body composition refers to the division of total body weight (mass) into components, most commonly fat mass and fat-free mass. The proportion of total body weight that is fat (referred to as percent body fat) is an important health-related indicator because high levels of body fatness are associated with increased risk of coronary heart disease, stroke, and diabetes. While children are not generally at risk for heart disease or stroke, elevated blood pressure and cholesterol occur in overweight and obese children. In addition, type 2 diabetes has increasingly been diagnosed among children, even though this condition has generally been viewed as “adult-onset” diabetes. Risk factors for obesity and heart disease are known to track through the life span, so it is important to document body composition as part of a comprehensive health-related fitness profile. Like other dimensions of health-related fitness, body composition does affect health status (even in childhood) and does improve with regular participation in physical activity.

A number of methods are available for estimating body fatness, but the most commonly used field measures are skinfold measurements and bioelectrical impedance analyzers. The skinfold approach involves the measurement of skinfold thicknesses at different parts of the body using a calibrated measurement tool called a caliper. The FITNESSGRAM skinfold procedure uses two sites that are easy to measure and whose measurements are not very invasive (triceps and calf). The measurements from these sites are then used in prediction equations to estimate body fatness. Bioelectric impedance analyzers use a very different approach to estimate body fatness. The devices send a small current through the body and measure resistance to current flow. A body with more muscle will have lower resistance to current flow, whereas a body with more fat will have greater resistance to current flow. While originally used only in research, a number of portable bioelectric impedance analyzer (BIA) devices are now commercially available at a price that is reasonable for most physical education programs (<$100). Because these devices can produce estimates of body composition faster than a skinfold test and do not require specific skill or experience, they may be a useful alternative to skinfold testing in some schools. The procedure is also less invasive than skinfold testing and may be better accepted in some districts that have specific policies against the use of skinfold calipers. However, the intuitive nature of skinfold testing also provides...
some unique educational advantages. Regardless of which approach is used, it is important to note that the estimates can vary by 2% to 3% of actual values. Body mass index (BMI) is another indicator of body composition. It is a commonly used index that provides an estimate of the appropriateness of a person’s weight in relation to his or her height. While it technically does not reflect body composition, it is an assessment that is widely used in determining weight status (e.g., overweight or obesity). The use of BMI may lead to inaccurate classifications of body composition in heavily muscled individuals, but it provides a good indicator of body composition for the majority of the population. An advantage of using BMI is that it allows for more direct comparisons with public health data released from state and national health departments. The FITNESSGRAM Scientific Advisory Board has historically recommended the reporting of body fat for assessments of body composition, but the popularity and ease of obtaining estimates of BMI make this an appropriate and acceptable measure. Details on collecting and scoring these assessments of body composition are provided in the following sections.

Need Additional Information?
For additional information on the advantages and disadvantages of various body composition measures and justification for the FITNESSGRAM Healthy Fitness Zone criteria, visit the FITNESSGRAM Reference Guide. The guide is available on the FITNESSGRAM website, www.fitnessgram.net (go to the Reference Guide section). Read the chapter “Body Composition Assessments” by Going, Lohman, and Falls.
placed into the Needs Improvement zone if he is in the overweight category and in the Needs Improvement—Health Risk zone if he is in the obese category. With body composition, there are also risks associated with being too lean, so there is a zone called Very Lean. Youth who score in this category will receive feedback about the importance of healthy eating and activity. While there are children who are naturally very lean, it is important to make parents aware that their children’s body composition places them in this category.

It is important to recognize that body fat and BMI provide different perspectives about a child’s body composition. The two assessments are based on different measures and cannot be expected to provide consistent information for all youth or to provide similar group distributions. However, the standards have been set up so that the BMI standards can be interpreted in a similar way as the body fat standards. If placed into the same fitness zone, students would receive similar information regardless of whether they are assessed with body fat or BMI.
Overview of the FITNESSGRAM Body Composition Standards (continued)

**Skinfold Measurements**

This section provides information on measuring skinfolds, including suggestions on performing the measurements.

**Equipment**

A skinfold caliper is necessary for performing this measurement. The caliper measures the thickness of a double layer of subcutaneous fat and skin at different parts of the body. The cost of calipers ranges from $5 to $200. Appendix A on page 85 lists a source for calipers, but it is important to know that training and practice are more important than the quality of the caliper for body composition assessment.

**Testing Procedures**

There are multiple procedures for skinfold testing. The FITNESSGRAM protocol involves collecting measurements from the triceps and calf. These sites have been chosen for FITNESSGRAM because they are easily measured and highly correlated with

(continued)
Body Composition

Skinfold Measurements (continued)

total body fatness. (An additional measure from the abdominal site is used for college students.) Following are details on the location of each of the sites as well as specific measurement tips.

- Triceps: The triceps skinfold is measured on the back of the right arm over the triceps muscle, midway between the elbow and the acromion process of the scapula. Using a piece of string to find the midpoint is a good suggestion. The skinfold site should be vertical. Pinching the fold slightly above the midpoint will ensure that the fold is measured on the midpoint.

- Calf: The calf skinfold is measured on the inside of the right leg at the level of maximal girth. The right foot is flat on an elevated surface with the knee flexed at a 90-degree angle. Grasp the vertical skinfold just above the level of maximal girth and take the measurement below the grasp.

- Abdomen (college students only): For college students, the formula for calculating percent body fat includes the abdominal skinfold measurement in addition to the triceps and calf skinfolds. The abdominal skinfold is measured at a site 3 centimeters to the side of the midpoint of the umbilicus and 1 centimeter below it. The skinfold is horizontal and should be measured on the right side of the body while the person relaxes the abdominal wall as much as possible.

For accurate information from skinfolds, it is important to use standardized techniques and to conduct assessments as consistently as possible. The following tips are recommended for accurate skinfold measurements:

- Measure skinfolds on the person’s right side.
- Instruct the student to relax the arm or leg being measured.
- Firmly grasp the skinfold between the thumb and forefinger and lift it away from the other body tissue. The grasp should not be so firm as to be painful.
- Place the caliper half an inch (~1.25 cm) below the pinch site.
- Be sure the caliper is in the middle of the fold.
- The recommended procedure is to do one measurement at each site before doing the second measurement at each site and finally the third set of measurements.
Skinfold Measurements (continued)

**PHOTO © Human Kinetics.** Triceps skinfold measurement.

**PHOTO © Human Kinetics.** Placement of the leg for locating the calf skinfold site.

**PHOTO © Human Kinetics.** Calf skinfold measurement.

**PHOTO © Human Kinetics.** Site of abdominal skinfold.

**PHOTO © Human Kinetics.** Abdominal skinfold measurement.

(continued)
Body Composition

Skinfold Measurements (continued)

**Scoring**
The skinfold procedure requires accurate estimates of skinfold thicknesses (measured in millimeters) as shown on the caliper. Each measurement should be taken three times, and the recorded score should be the median (middle) value of the three scores. For example, if the readings were 7.0, 9.0, and 8.0, the score would be recorded as 8.0 millimeters. Each reading should be recorded to the nearest .5 millimeter. *FITNESSGRAM* uses the formula developed by Slaughter and Lohman to calculate percent body fat (Slaughter et al., 1988).

**Body Mass Index**
The BMI provides an indication of the appropriateness of a child’s weight relative to height. Body mass index is determined by the following formula: \( \text{BMI} = \frac{\text{weight (kg)}}{\text{height}^2 \text{(m)}} \). An example is provided to demonstrate how weight and height interact to influence the BMI score.

A student weighing 100 pounds (45.36 kg) who is 5 feet (1.52 m) tall would have a BMI of 19.6. Another student of the same weight but 5 feet 2 inches (1.57 m) tall would have a BMI of 18.3. The same weight is more appropriate for the slightly taller person, so the BMI is slightly lower.

Height and weight measures can be entered in pounds and inches, but they are converted to metric units to calculate BMI—pounds to kilograms and feet to meters. This section describes how to collect height and weight data and how the results can be interpreted.

**Equipment**
To collect information about BMI, it is important to obtain accurate measures of height and weight. A stadiometer is recommended for obtaining accurate measurements of height. The use of a tape measure attached to a wall will not be as accurate. For weight, a high-quality digital scale is recommended. Portable stadiometers and digital scales are available for reasonable prices and are a worthwhile investment.

**Testing Procedures**
To obtain accurate data on height and weight, it is important to measure children without their shoes on. Shoes can be heavy and also can increase a person’s height. Therefore, use this procedure for all measurements. In measuring height and weight, you are encouraged to drop fractions of an inch or a pound and use the lower whole number. For example, a height of 5 feet 5.5 inches would be recorded as 5 feet 5 inches, and a weight of 112.5 pounds would be recorded as 112 pounds. Use of the *FITNESSGRAM* software allows for use of decimals when recording height and weight.

**Scoring**
The general values defining overweight in adults is a value less than 25 (for both males and females). However, boys and girls have BMI values that are very different due to the dramatic changes in growth and development that occur with age. Therefore, age and sex-specific values of BMI are used to assess weight status for youth.

A score that is classified as Needs Improvement generally indicates that a child weighs too much for his or her height. Body mass index is not the recommended procedure for determining body composition because it does not estimate the percent of fat. It merely provides information on the appropriateness of the weight relative to the height. For children found to be too heavy for their height, a skinfold test would clarify whether the weight is due to excess fat.
Portable Bioelectric Impedance Analyzers

A number of portable bioelectric impedance analyzers (BIA) devices are now commercially available at a price that is reasonable for most physical education programs (<$100). These devices estimate body composition by measuring the body’s resistance to current flow. A body with more muscle will also have more total body water (and therefore have low resistance to current flow). A body with more fat will have less total body water and greater resistance to current flow. One type of device requires participants to stand on an instrument resembling a bathroom scale while barefoot. Another type of device uses a handgrip system that has participants squeeze handles while extending the arms.

Preliminary results with these devices suggest that they provide similar accuracy of classification and estimates of body composition as skinfold calipers provide. Because these devices can produce estimates of body composition faster than a skinfold test and do not require specific skill or experience, they may provide a useful alternative to skinfold testing in some schools. The procedure is also less invasive than skinfold testing and may be better accepted in some districts that have specific policies against the use of skinfold calipers.

Additional Recommendations

Suggestions for Test Administration

- Body composition testing should be conducted in a setting that provides each child with privacy.
- Interpretation of the measurements may be given in a group setting as long as individual results are not identified.
- Whenever possible, the same tester should conduct the measurements to ensure consistency.
- Measuring should be practiced, and repeat measurements are recommended occasionally for ensuring accuracy. Once familiar with the methods, testers can generally find agreement within 10%.

Learning to Do Skinfold Measurements

Using video training and participating in workshops are excellent ways to learn skinfold measurements.