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UWTSD Sport and Exercise Science Physiological Testing Protocols

Skinfold Estimations of Body Composition

Taken From:

Lab 34

**Housh, T.J., Cramer, J.T., Weir, J.P., Beck, T.W. and
Johnson, G.O. (2016). Laboratory manual for
Exercise Physiology, Exercise Testing and Physical
Activity. London: Routledge.**

BACKGROUND

Laboratory methods for body composition assessment represent the most accurate means available for determining the amount of fat and fat-free tissue in live subjects. Generally, underwater weighing is considered the “gold standard” for determining body composition characteristics. Often, however, underwater weighing is not practical for assessing large groups of subjects in field situations.

Assessment of body composition by skinfold measurements is a simple and relatively accurate method that requires minimal equipment and can be used with large numbers of subjects in a field setting. Skinfold measurements can be used in multiple regression “prediction” equations to estimate body composition (body density [DB], percent fat [% FAT], fat-free weight [FFW], fat weight [FW]). The results of skinfold methods to determine body composition are usually within 3% to 5% of underwater weighing.

The ability to predict body composition from skinfolds is simply based on the fact that fat or fat-free tissues accumulate in relatively predictable patterns in similarly aged individuals of the same gender. Therefore, if specific sites are measured, the measurements will be influenced by the amount of the individual’s adipose or fat-free tissue.

In this laboratory the technique for skinfold measurement will be outlined, and you will use the measurements to predict various aspects of body composition.

KNOW THESE TERMS & ABBREVIATIONS

- DB = body density
- FFW = fat-free weight
- FW = fat weight
- FAT = percent fat

PROCEDURES

1. Measure and mark the anatomical sites with a marker (see sites below in photos 34.1 through 34.15). Three sites are to be measured for each gender. Both males and females are measured at the thigh site. Males are also measured at the chest and abdomen, females at the triceps and suprailium.
2. Take all measurements on the right side of the body.
3. Grasp the skinfold of the subject firmly with the thumb and forefinger and pull away from the body.
4. Hold the caliper perpendicular to the skinfold. The caliper should be approximately 1 cm away from the thumb and forefinger so that the pressure of the caliper will not be affected.
5. Read the skinfold size approximately 1 to 2 seconds after the caliper thumb grip has been released.
6. Take three measurements per site at least 15 seconds apart to allow the skinfold site to return to normal. If the repeated measurements vary by more than 1 mm, more measurements should be taken. Use the mean of the recorded measurements that are within 1 mm as the representative skinfold value in the equation.
7. Calculate body composition characteristics using worksheet 34.1.

Equations

Males (ages 18–61 years)

$$DB = 1.1093800 - (0.0008267 (X2)) + (0.0000016 (X2)^2) - (0.0002574 (X4))$$

$$R = 0.91$$

$$SEE = 0.008 \text{ kg} \cdot L^{-1}$$

X2 = sum of chest, abdomen, and thigh skinfolds in mm

X4 = age in years

Females (ages 18–55 years)

$$DB = 1.099421 - (0.0009929 (X3)) + (0.0000023 (X3)^2) - (0.0001392 (X4))$$

$$R = 0.84$$

$$SEE = 0.009 \text{ kg} \cdot L^{-1}$$

X3 = sum of triceps, thigh, and suprailium skinfolds in mm

X4 = age in years

SEE = standard error of estimate, R = multiple correlation coefficient

$$\% \text{ FAT} = (((4.57 / DB) - 4.142) \times 100)^{1/2}$$

$$FW = \text{body weight} \times (\% \text{ FAT} / 100)$$

$$FFW = \text{body weight} - FW$$

$$\text{body weight goal} = FFW / (1 - (\text{target } \% \text{ FAT} / 100))$$

Skinfold Sites

CHEST (see [photos 34.1–34.3](#)): a diagonal fold taken one half of the distance between the anterior axillary line and the nipple (males).



PHOTO 34.1 Chest skinfold measurement.

ABDOMEN (see [photos 34.4–34.6](#)): a vertical fold taken at a lateral distance of approximately 2 cm from the umbilicus (males).



PHOTO 34.4 Abdomen skinfold measurement.

THIGH (see [photos 34.7–34.9](#)): a vertical fold on the anterior aspect of the thigh, midway between hip and knee joints (males and females).



PHOTO 34.7 Thigh skinfold measurement.

TRICEPS (see [photos 34.10–34.12](#)): a vertical fold on the posterior midline of the upper arm, halfway between the acromion and olecranon processes; the elbow should be extended and relaxed (females).



PHOTO 34.10 Triceps skinfold measurement.

SUPRAILIUM (see [photos 34.13–34.15](#)): a diagonal fold above the crest of the ilium at the spot where an imaginary line would come down from the anterior axillary line (females).



PHOTO 34.13 Suprailium skinfold measurement.

Note: For accurate measures, do not take measurements when the skin is wet, immediately after exercise, or when the subject is overheated.

Worksheet 34.1 SKINFOLD ESTIMATIONS OF BODY COMPOSITION

Name _____ Date _____

Gender: _____

Age: _____ years

Body weight: _____ kg

Skinfold Measurements (mm)

	Trial 1	Trial 2	Trial 3	Mean
Triceps	_____	_____	_____	_____
Suprailium	_____	_____	_____	_____
Abdomen	_____	_____	_____	_____
Thigh	_____	_____	_____	_____
Chest	_____	_____	_____	_____

Sum of chest, abdomen, and thigh skinfolds = _____

Sum of triceps, thigh, and suprailium skinfolds = _____

Use the gender-specific equations on p. 259 to calculate DB.

DB = _____ $\text{kg} \cdot \text{L}^{-1}$

Use the equations on p. 259 to calculate % FAT, FW, and FFW.

% FAT = _____ % FW = _____ kg FFW = _____ kg

REFERENCES

1. Brozek, J., Grande, F., Anderson, J. T., and Keys, A. Densitometric analysis of body composition: Revision of some quantitative assumptions. Ann. N.Y. Acad. Sci. 110: 113–140, 1963.
2. Harrison, G. G., Buskirk, E. R., Carter, J. E. L., Johnston, F. E., Lohman, T. G., Pollock, M. L., Roche, A. F., and Wilmore, J. Skinfold thicknesses and measurement techniques. In Anthropometric Standardization Reference Manual, eds. T. G. Lohman, A. F. Roche, and R. Martorell. Champaign, IL: Human Kinetics, pp. 55–70, 1988.
3. Jackson, A. S., and Pollock, M. L. Practical assessment of body composition. Phys. Sportsmed. 13: 76–90, 1985

Sample Calculations

Gender: Male

Body weight: 80.0 kg

Age: 25 years

Sum of chest, abdomen, and thigh skinfolds: 40 mm

$$DB = 1.1093800 - (0.0008267 (40)) + (0.0000016 (40)^2) - (0.0002574 (25))$$

$$DB = 1.1093800 - 0.03307 + 0.00256 - 0.006435 = 1.0724 \text{ kg} \cdot L^{-1}$$

$$\% \text{ FAT} = ((4.57 / 1.0724) - 4.142) \times 100 = 11.9 \% \text{ FAT}$$

$$FW = 80.0 \times (11.9 / 100) = 9.5 \text{ kg}$$

$$FFW = 80.0 - 9.5 = 70.5 \text{ kg}$$

$$\text{body weight goal of } 8.0 \% \text{ FAT} = 70.5 / (1 - (8.0 / 100)) = 76.6 \text{ kg}$$

Gender: Female

Body weight: 65 kg

Age: 30 years

Sum of triceps, thigh, and suprailium skinfolds: 55 mm

$$DB = 1.099421 - (0.0009929 (55)) + (0.0000023 (55)^2) - 0.0001392 (30)$$

$$DB = 1.099421 - 0.05461 + 0.00696 - 0.004176 = 1.0476$$

$$\% \text{ FAT} = ((4.57 / 1.0476) - 4.142) \times 100 = 22.0 \%$$

$$\text{FAT FW} = 65 \times (22.0 / 100) = 14.3 \text{ kg}$$

$$FFW = 65 - 14.3 = 50.7 \text{ kg}$$

$$\text{body weight goal of } 15.0 \% \text{ FAT} = 50.7 / (1 - (15.0 / 100)) = 59.6 \text{ kg}$$