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UWTSD Sport and Exercise Science Physiological Testing Protocols

Anthropometric Measures of Health Risk

Taken From:

Lab 35

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BACKGROUND

Three primary anthropometric-based parameters that can provide information regarding the risk of developing cardiovascular disease, type 2 diabetes, dyslipidemia, obesity, and/or hypertension are body mass index (BMI), waist-to-hip ratio, and waist circumference.^{1,3,4,5,8} Each of these parameters can be used to classify individuals with regard to their health risk. In addition, they are commonly used in epidemiological studies because they are associated with various diseases and risk factors, require few measurements, and are simple to calculate.

In this laboratory, the techniques and landmarks for measuring height and body weight, as well as waist 1, waist 2, and hips circumferences, will be described, and you will use them to determine the BMI, waist-to-hip ratio, and waist 2 circumference. You will also learn to classify an individual's health risk based on these parameters.

KNOW THESE TERMS & ABBREVIATIONS

- anthropometric = relating to the measurement of the size and proportions of the human body
- BMI = body mass index: body weight in kg/height in meters squared ($\text{kg} \cdot \text{m}^{-2}$)
- epidemiological studies = studies performed on human populations that attempt to link health



PHOTO 35.1 Measurement of height.

effects to a cause; e.g., waist circumference and type 2 diabetes

PROCEDURES^{1,5,6}

1. Measure the subject's height in meters (cm/100) and body weight in kg with the shoes removed (see photos 35.1 and 35.2). Record the values on worksheet 35.1.
2. Identify the landmarks for the waist 1, waist 2, and hips circumferences (see photos 35.3, 35.4, and 35.5).
3. Place the tape parallel to the floor (horizontal).
4. Hold the tape firmly around the circumference site, but do not compress the underlying tissue.
5. Take three measurements per site and use the mean of repeated recordings that agree within 0.5 cm. Record measurements on worksheet 35.1.

Circumference Sites in cm^{1,2,6,8}

Waist 1 (see photo 35.3): at the level of the “natural waist,” midway between the xyphoid process and umbilicus

Waist 2 (see photo 35.4): at the level of the umbilicus and iliac crests

Hips (see photo 35.5): at the level of the pubis symphysis and the maximal protrusion of the gluteal muscles



PHOTO 35.3 Measurement of waist 1 circumference, at the natural waist.



PHOTO 35.4 Measurement of waist 2 circumference, at the level of the umbilicus and iliac crests.



PHOTO 35.5 Measurement of hips circumference, at the level of the symphysis pubis and maximal gluteal protrusion.

TABLE 35.1 Mean ($\pm$ SEM) height (cm) values by age categories.⁸

Age (years)	Males	Females
17	175.3 $\pm$ 0.57	163.1 $\pm$ 0.56
18	176.4 $\pm$ 0.65	163.1 $\pm$ 0.44
19	176.7 $\pm$ 0.64	162.9 $\pm$ 0.64
20–29	176.7 $\pm$ 0.29	162.8 $\pm$ 0.31
30–39	176.4 $\pm$ 0.26	163.1 $\pm$ 0.28
40–49	177.2 $\pm$ 0.33	163.4 $\pm$ 0.24
50–59	175.8 $\pm$ 0.32	162.3 $\pm$ 0.35
60–69	174.8 $\pm$ 0.33	160.6 $\pm$ 0.27
70–79	172.7 $\pm$ 0.44	159.0 $\pm$ 0.31
80 and over	170.7 $\pm$ 0.44	155.8 $\pm$ 0.34

TABLE 35.2 Mean ($\pm$ SEM) body weight (kg) values by age categories.⁸

Age (years)	Males	Females
17	75.6 $\pm$ 1.38	61.7 $\pm$ 1.21
18	75.6 $\pm$ 1.12	65.2 $\pm$ 1.52
19	78.2 $\pm$ 1.29	67.9 $\pm$ 1.21
20–29	83.4 $\pm$ 0.70	71.1 $\pm$ 0.90
30–39	86.0 $\pm$ 0.90	74.1 $\pm$ 0.91
40–49	89.1 $\pm$ 0.73	76.5 $\pm$ 1.09
50–59	88.8 $\pm$ 0.94	76.9 $\pm$ 1.15
60–69	88.2 $\pm$ 0.73	76.3 $\pm$ 0.76
70–79	82.7 $\pm$ 0.71	71.0 $\pm$ 0.76
80 and over	76.0 $\pm$ 0.66	63.7 $\pm$ 1.31

Mean ($\pm$ SEM) BMI values by age categories. ⁸			TABLE	35.3
Age (years)	Males	Females		
17	24.5 $\pm$ 0.41	23.1 $\pm$ 0.41		
18	24.2 $\pm$ 0.34	24.4 $\pm$ 0.48		
19	24.9 $\pm$ 0.36	25.5 $\pm$ 0.43		
20–29	26.6 $\pm$ 0.19	26.8 $\pm$ 0.29		
30–39	27.5 $\pm$ 0.26	27.9 $\pm$ 0.33		
40–49	28.4 $\pm$ 0.25	28.6 $\pm$ 0.40		
50–59	28.7 $\pm$ 0.31	29.2 $\pm$ 0.40		
60–69	28.9 $\pm$ 0.20	29.6 $\pm$ 0.30		
70–79	27.7 $\pm$ 0.18	28.0 $\pm$ 0.29		
80 and over	26.1 $\pm$ 0.23	26.1 $\pm$ 0.48		

Health risk classifications for BMI. ⁵			TABLE	35.4
BMI (kg $\cdot$ m ⁻²)	Weight classification	Health risk		
<18.5	Underweight	Increased		
18.5–24.9	Normal weight	Average		
25.0–29.9	Overweight	Increased		
≥ 30	Obese	High		

Note: Underweight, overweight, and obese classifications are associated with various diseases such as hypertension, dyslipidemia, and cardiovascular disease.¹

TABLE 35.5 Health risk classifications for cardiovascular disease associated with waist-to-hip ratio by age categories.^{4,6,7}

Males				
AGE (YEARS)	LOW	MODERATE	HIGH	VERY HIGH
20–29	<0.83	0.83–0.88	0.89–0.94	>0.94
30–39	<0.84	0.84–0.91	0.92–0.96	>0.96
40–49	<0.88	0.88–0.95	0.96–1.00	>1.00
50–59	<0.90	0.90–0.96	0.97–1.02	>1.02
60–69	<0.91	0.91–0.98	0.99–1.03	>1.03
Females				
AGE (YEARS)	LOW	MODERATE	HIGH	VERY HIGH
20–29	<0.71	0.71–0.77	0.78–0.82	>0.82
30–39	<0.72	0.72–0.78	0.79–0.84	>0.84
40–49	<0.73	0.73–0.79	0.80–0.87	>0.87
50–59	<0.74	0.74–0.81	0.82–0.88	>0.88
60–69	<0.76	0.76–0.83	0.84–0.90	>0.90

Note: Waist-to-hip ratio uses waist 1 circumference.

TABLE 35.6 Chronic disease classifications for waist 2 circumference.³

CHRONIC DISEASE RISK	FEMALES	MALES
Very low	<70	<80
Low	70–89	80–99
High	90–110	100–120
Very high	>110	>120

Note: Chronic diseases include type 2 diabetes, hypertension, and cardiovascular disease.¹

ANTHROPOMETRIC MEASURES OF HEALTH RISK FORM Worksheet 35.1

Name _____ Date _____

Gender: _____

Age: _____ years

Body Weight: _____ kg

Height: _____ cm / 100 = _____ meters

	Trial 1	Trial 2	Trial 3	Mean
Waist 1 circumference (cm)	_____	_____	_____	_____
Waist 2 circumference (cm)	_____	_____	_____	_____
Hips circumference (cm)	_____	_____	_____	_____

BMI = body weight in kg / height in m² = _____ kg / _____ m² = _____

Classification = _____ (table 35.4)

Waist-to-hip ratio = waist 1 circumference in cm / hips circumference in cm =

_____ cm / _____ cm = _____

Classification = _____ (table 35.5)

Waist 2 circumference = _____ cm

Classification = _____ (table 35.6)

REFERENCES

1. American College of Sports Medicine. ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription, 9th edition. Baltimore: Wolters Kluwer/Lippincott Williams & Wilkins, 2014.
2. Behnke, A. R., and Wilmore, J. H. Evaluation and Regulation of Body Build and Composition. Englewood Cliffs, NJ: Prentice-Hall, 1974.
3. Bray, G. A. Don't throw the baby out with the bath water. Am. J. Clin. Nutr. 79: 347–349, 2004.

4. Bray, G. A., and Gray, D. S. Obesity Part 1—Pathogenesis. *West. J. Med.* 149: 429–441, 1988.
5. Expert Panel on the Identification, Evaluation, and Treatment of Overweight in Adults. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: Executive summary. *Am. J. Clin. Nutr.* 68: 899–917, 1998.
6. Heyward, V. H., and Stolarczyk, L. M. *Applied Body Composition Assessment*. Champaign, IL: Human Kinetics, 1996, pp. 81–82.
7. Hoffman, J. *Norms for Fitness, Performance, and Health*. Champaign, IL: Human Kinetics, 2006, p. 87.
8. McDowell, M. A., Fryar, C. D., Hirsch, R., and Ogden, C. L. *Anthropometric Reference Data for Children and Adults: U.S. Population, 1999–2002*. Hyattsville, MD: Centers for Disease Control and Prevention, 2005.