

## CIRCUMFERENCE MEASUREMENTS

### 1. Background and Purpose

Recent data suggest neck circumference, as a measure of central obesity, is better correlated with obstructive sleep apnea (OSA) than is BMI<sup>1</sup>. In particular, among subjects with a BMI <28kg/m<sup>2</sup>, an increased neck size may identify those with OSA<sup>2</sup>. Increased neck size, as a marker for upper airway compromise, may be a direct risk factor for OSA.

### 2. Equipment

Gulick II Tape measure is recommended. The model # is 67021

This tape measurer applies tension and allows for accurate and repeatable body measurements. You can order it from Country Technology, PO Box 87, Gray Mills, WI 54631. Telephone: 608-735-4718.

### 3. Definitions

Frankfort Horizontal Plan - head parallel to the floor looking straight ahead  
Laryngeal prominence - also known as the Adams apple, located in the throat

### 4. Neck Circumference

The method described by Callaway et al in Lohman, Rocke, and Martorell<sup>3</sup> will be used to measure the circumference of the neck.

Perform and record this measurement in triplicate

Participant sits upright with the head in the Frankfort Horizontal Plane

An inelastic tape is applied around the neck just below the laryngeal prominence

Measurement is made perpendicular to the long axis of the neck (which is not necessarily in the horizontal plane)

Tape should be placed in such a way as to minimize the measurement

Pressure on the tape should be minimum required to maintain skin contact

Measurement should be completed in less than 5 seconds, to avoid participant discomfort

Circumference of the neck is measured to the nearest 0.1 cm (round up).

### References

1. Stradling JR, Crosby JH. Predictors and prevalence of obstructive sleep apnea and snoring in 1001 middle-aged men. Thorax 1991; 46:85-90.
2. Carlson JT, Hedner JA, Ejnell H, Peterson LE. High prevalence of hypertension in sleep apnea patients independently of obesity. Am J Respir Crit Care Med 1994; 150:72-77.

3. Callaway CW, Chumlea WC, Buchard C et al. Circumferences. In Lohman TG, Roche AF Martorell R, eds, Anthropometric Standardization Reference Manual, Human Kinetic Books, Champaign, IL, 1988, pp 41-45.

### **5. Waist Circumference**

The subject should wear little clothing so that the tape may be correctly positioned. The measurement should not be made over clothing. If clothing must be worn, subjects should undress to light underwear and wear only a cloth or paper smock during the measurement. The subject stands erect with the abdomen relaxed, the arms at the sides and feet shoulder width apart. The measurer faces the subject and places an inelastic tape around the subject, at the level of the natural waist, which is the narrowest part of the torso. An assistant is needed to help position the tape in a horizontal plane. In some obese subjects, it may be difficult to identify a waist narrowing. In such cases, the smallest horizontal circumference should be measured in the area between the ribs and iliac crest. The measurement should be taken at the end of a normal expiration, without the tape compressing the skin. It is recorded to the nearest 0.1 cm and should be done three times.

Please note that the participant's arms may be raised as you are placing the tape, but the arms should be at the side when the measurement is made.

### **6. Hip Circumference**

The subject should wear only nonrestrictive briefs or underwear, or a light smock over underwear. The subject stands erect with arms at the sides and feet shoulder width apart. The measurer squats at the side of the subject so that the level of maximum extension of the buttocks can be seen. An inelastic tape is placed around the buttocks in a horizontal plane at this level without compressing the skin. An assistant is needed to help position the tape on the opposite side of the subject's body. A mirror may also be used to help assist. The zero end of the tape should be below the measurement value. The tape is in contact with the skin but does not indent the soft tissue. The measurement is done to the nearest 0.1 cm and should be done three times.

Please note that the participant's arms may be raised as you are placing the tape, but the arms should be at the side when the measurement is made.