growth is much stronger than the similar effect of testosterone in boys. In boys, the prolonged growth period before puberty and the less rapid epiphyseal closure are reflected in their greater overall height and longer arms and legs. Other skeletal differences are increased shoulder width in boys and broader hip development in girls.

Hypertrophy of the laryngeal mucosa and enlargement of the larynx and vocal cords occur in both boys and girls to produce **voice changes**. Girls' voices become slightly deeper and considerably fuller, but the effect in boys is striking. The change in the voice of adolescent boys occurs between Tanner stages 3 and 4, with the voice often shifting uncontrollably from deep to high tones in the middle of a sentence. The average lengthening of the vocal cords is 10.9 mm (0.4 inch) for boys and 4.2 mm (0.17 inch) for girls.

Growth of **lean body mass**, principally muscle, which tends to occur after the bone growth spurt, takes place steadily during adolescence. Lean body mass is both quantitatively and qualitatively greater in boys than in girls at comparable stages of pubertal development. **Nonlean body mass**, primarily fat, is also increased but follows a less orderly pattern. There may be a transient increase in subcutaneous fat just before the skeletal growth spurt, especially in boys. This is followed 1 to 2 years later by a modest to marked decrease, which is again more marked in boys. Later, variable amounts of fat are deposited to fill out and contour the mature physique in patterns characteristic of the adolescent's sex, particularly in the regions over the thighs, hips, and buttocks and around the breast tissue. It should be noted, however, that pediatric obesity is steadily on the increase in the United States, and obesity can change the timing and sequence of puberty. This may have long-term effects for increased risk of adult adiposity and obesity (Bralic, Tahirovic, Matanic, et al, 2012). A review of recent evidence indicates an association between obesity and onset of early puberty in girls rather than a causal relationship, and other factors such as hormones and insulin resistance may account for early onset puberty as well. No correlations between body fat and earlier puberty in boys have been reported (Biro, Greenspan, and Galvez, 2012).

Other Physiologic Changes