Oversimplification of the Relationship between Ultrasound and Skinfold Measurements of Subcutaneous Fat Thickness

Dear Editor-in-Chief,

In the March 2021 issue of *Medicine & Science in Sports & Exercise*, two separate studies (1,2) from different research laboratories both used ultrasound to estimate body fat percentage (%BF). Both Chandler et al. (1) and Tinsley et al. (2) reported using a modification of the Jackson–Pollock (3) seven-site skinfold formula to convert their ultrasound fat thicknesses into estimates of body density and subsequently converted body density to %BF with the Siri (4) formula. Close inspection of their methods reveals that the only "modification" to the Jackson–Pollock equation was a doubling of the ultrasound fat thicknesses. Tinsley et al. provided a rationale for this by stating "values were doubled to reflect the values obtained by skinfold (i.e., a double layer of subcutaneous tissue)" (p. 661). Neither Chandler et al. (1) nor Tinsley et al. (2) provided any citation or corroborating evidence that an ultrasound fat thickness measurement is exactly half that of a skinfold measurement at a given site. I contend that this assumption is erroneous.

The very nature of the skinfold technique requires grasping and compressing the fat in order to take the measurement with calipers. Thus, the measurement is a *compressed* double layer of subcutaneous tissue, not merely "a double layer of subcutaneous tissue." In contrast, assuming proper technique, ultrasound provides an uncompressed, "true" measure of fat thickness, and this is one of the main advantages cited for using the ultrasound method over the skinfold method (5,6). Consequently, a skinfold measurement is not simply a doubling of an ultrasound measurement.

One can only speculate on the magnitude of error that might occur if ultrasound thickness is not exactly half of skinfold thickness. For example, Müller et al. (7) suggested that the ratio of skinfold thickness to ultrasound thickness might be closer to 1.6 than 2.0 at some measurement sites. This is a 20% difference or error from the assumed doubling. However, the compressibility of subcutaneous adipose tissue is not constant throughout the body or from individual to individual, making it difficult to quantify the ratio of skinfold to ultrasound thicknesses (7).

Further complicating the "doubling" relationship between ultrasound and skinfolds is the issue of skin thickness. Neither Chandler et al. (1) nor Tinsley et al. (2) mentioned whether the dermis and epidermis were included in their ultrasound measures of subcutaneous tissue thickness. This might seem inconsequential, but it is meaningful, particularly for very lean individuals such as the participants in the Chandler et al. (1) study who had a mean body mass index of 18.3 and 20.5 $kg \cdot m^{-2}$ for females and males, respectively. For example, a skin thickness of 1 mm accounts for one-third of the total measurement on a subcutaneous fat thickness site of 3 mm.

Ultrasound is an accurate method for measuring subcutaneous adipose tissue thickness at individual measurement sites (6–8), and it is encouraging to see the research teams of Chandler et al. (1) and Tinsley et al. (2) incorporate this technology in their body composition studies. However, it is an oversimplification to just double the ultrasound thicknesses and assume that measurement will work in an existing skinfold equation to estimate total %BF. Importantly, assuming that fat thickness measured by ultrasound is exactly half that measured by skinfold is faulty logic and a practice that should be avoided.

Dale R. Wagner
Kinesiology & Health Science Department
Utah State University, Logan, UT

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