In this multipart series on body fat testing, you've learned that it can be highly inaccurate in individuals, whether for a one-time measurement, or when measuring change over time. So far you've learned about hydrostatic weighing, the Bod Pod, and BIA. Now let's talk about skinfolds.

Skinfold Testing

Skinfold testing involves taking a device known as a caliper, pinching the skin and fat underneath the skin (known as subcutaneous fat), pulling the skinfold away from the underlying muscle, and measuring the thickness of the skinfold with the caliper. This is done at numerous sites around the body (usually 3-7 separate sites). The skinfold thicknesses are all added together, and plugged into an equation along with your age. The equation spits out your body density, which is the relationship of your body volume (how much space your body takes up) to your body weight. Lean tissue takes up less space than fat tissue for a given weight, and is thus more dense. Therefore, the greater your body density, the more lean tissue and less fat tissue you have. This body density can then be converted into a body fat percentage using another equation, such as the Siri equation which I talked about in the article on underwater weighing.

There are many sources of error with this technique. First, the technique is highly sensitive to how skilled the technician is at grabbing the fat and pulling it away from the underlying muscle tissue. Improper technique can introduce error into the results. I remember performing a skinfold on a cheerleader when I was a graduate student at Washington State University. She didn't like the result I had, so she asked one of the strength coaches to perform the skinfold. He performs the test, telling me that you have to "wiggle the calipers" when you perform the test (which you aren't supposed to do). Well, all he was doing was wiggling some of the skinfold out from between the calipers, and of course he came up with a lower number than I did simply by using an incorrect technique.

Another source of error is in the equation used to predict body density. The Jackson-Pollock equation is one of the most common equations used with skinfolds. However, an equation is only valid when testing people similar to the people used to develop the equation in the first place. For example, the male version of the Jackson-Pollock equation was developed on men between the ages of 18 and 61 years of age. Thus, the prediction accuracy falls off when you get outside of this age range. Also, the Jackson-Pollock equations were developed on white men and women; however, as I pointed out in my article on hydrostatic weighing, the density of fat-free mass can change depending upon your race. Thus, there will be greater error when using the Jackson-Pollock equation if you are not white. Therefore, it is critical that, if you do use skinfolds for body fat estimation, you use an equation that was specifically developed for your race, age, and gender.

Another problem we have is similar to the problem we had with BIA. Like with BIA, skinfold testing is a prediction based off of a prediction. Skinfold testing equations, like the Jackson-Pollock equation, were developed off of hydrostatic weighing measurements (which themselves are predictions with error). Thus, if hydrostatic weighing can have an error rate of up to 5-6% in individuals, then skinfold testing equations are going to compound that error.

Finally, we have the same problem that we have with all 2-compartment models...the assumption that fat-free mass has a certain density. As I pointed out in the article on hydrostatic weighing, the density of fat-free mass can change with changes in body weight, which will introduce error when measuring a change in body fat over time.

Thick Errors

Skinfolds can have pretty sizeable errors when compared to a 4-compartment model, whether you're looking at group averages or individuals. In one study, skinfolds (using the Jackson-Pollock equation) underpredicted body fat percentage in white women by 6%, and that's the average for the entire group. The individual error rates were huge, ranging from an overprediction of 10% to an underprediction of over 15%. For men, the error rates were no better. Using the Durnin and Womersley equation, the individual error rates got as high as 10-15% in both directions.

And what about measuring change over time? In one study on obese women who lost weight, skinfolds did reasonably well when looking at group averages, underpredicting the change in body fat percentage by about 1%. However, individual error rates were higher, with underpredictions of around 5% to overpredictions of around 3%. This means you could lose 5% body fat but skinfolds would not show any change, or skinfolds could tell you that you lost 6% body fat when you really only lost 3%. Similar average and individual error rates were seen in a study on bodybuilders.

Skinfolds: The Verdict

Like BIA, skinfolds can be way off when it comes to determining body fat percentage in individuals. When it comes to tracking change over time in groups, then skinfolds do pretty well. However, errors for tracking change in individuals over time can be up to 3-5%. Thus, if you are going to use skinfolds for tracking a single person over time, I recommend very long time intervals between measurements (minimum of 3 months but 6 months is better); otherwise, the error rate is higher than the change that you can see. In fact, I recommend against even calculating a body fat percentage. If skinfold thicknesses are going down, then you are likely losing fat.

That sums it up for the most widely used 2-compartment models for testing body fat. Click here to read Part 6 of this series, where I discuss dual-energy x-ray absorptiometry (DEXA), a 3-compartment model for estimating body composition...
