

## **Body Composition Analysis**

### **Comparison of Bioelectrical Impedance Instruments versus Near-Infrared Instruments**

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#### **Introduction**

During the last twenty-five years, the importance of knowing percent body fat in terms of basic health and athletic performance has been clearly recognized. This recognition coincided when NIH published, based upon their Framingham Studies, that percent body fat is an independent health risk instead of the previous grouping of body fat in the so-called "Body Weight Health Risk." Coupled with this knowledge, two alternate technologies became available allowing percent body fat to be conveniently measured for determining percent body fat. These two technologies are:

- Bio-electric Impedance Analysis ("BIA"), and
- Near-infrared Interactance ("NIR").

Today there are thousands of such instruments in use throughout the world. However, there has not been a systematic evaluation of the benefits and the disadvantages of these two competing technologies for the measurement of percent body fat. This Technical Note provides a brief summary of extensive research that was performed at our institute to evaluate both of the techniques.

#### **Limitations of Our Study**

There are currently two different classes of instruments that measure percent body fat. There are low-cost home units that typically sell for less than \$100. Another class of body composition analyzers, called ***professional models***, is typically in the \$2,000 to \$5,000 price range. This study was limited to only the professional models - - - instruments designed for use where accuracy and repeatability are the primary needs.

#### **Instruments Investigated**

For BIA instruments, two different professional models were included in this investigation. They are:

- Tanita Model MC-980 Professional Body Composition Analyzer (from Tanita, Inc.), and
- InBody Model 720 Professional Body Composition Analyzer (from Biospace, Inc).

For NIR devices, the study included the FUTREX-6100 and the Bod-eComm2 Analyzer (both from Futrex, Inc.).

### **Literature Search**

All of the above described instruments are both FDA and CE cleared devices. Thus, all four had to demonstrate that their accuracy and precision was equivalent to hydrostatic weighing (the so called Gold Standard). However, unfortunately, the FDA Form 510(k) submittals for the BIA instruments did not describe what restrictions, if any, were in place when the volunteers were measured.

### **NIH Defined BIA Restrictions**

NIH publications<sup>1,2,3</sup> describe the basic technique of performing BIA measurements. They also list a series of “restrictions” on when such BIA measurements can be made. NIH explained that the reason for these restrictions is that the basic technique of BIA measurements is to actually measure both the hydration level as well as the electrolyte level of the body. These measurement parameters are then used to *calculate* the percent body fat.

Unfortunately, the hydration level of the body varies considerably during the day. The actual hydration level depends upon, among other things, the amount of fluid intake of the body, the loss of fluid due to normal daily activities, voiding, and other activities including perspiring during exercise. Similarly, the electrolytes contained within the body also vary considerably during the day by what is eaten, the amount of perspiration, and other items such as hand lotions. This varying hydration level and electrolyte level directly affects the *calculation* of percent body fat.

To minimize these effects, the NIH listed the following parameters to when measurement is made by BIA instruments. Their recommendations include:

- No BIA measurement should be made within two to four hours after having eaten a meal.
- No BIA measurement should be made within 24 hours of having consumed any alcoholic beverages.
- No BIA measurement should be made within three to four hours of having exercised.
- No BIA measurement should be made within two hours after using hand creams or similar types of lotions.
- No BIA measurement should be made during a woman’s menstrual cycle.

In addition to the above limitation on when measurements should be made, there are two safety issues that should be considered. They are:

- Persons with heart pacemakers should avoid being measured through BIA because the low level alternating electrical currents used in BIA measurements might interfere with the pacemaker’s performance.
- Persons with internal heart defibrillators should avoid measurement by BIA to eliminate the possibility that the device may be activated as the BIA alternating currents flow through the body.

The above restrictions may have no meaningful affect for hospitalized patients. Under such controlled conditions all the restrictions can be easily met. However, in other applications such as in health clubs or wellness centers, where you can't directly control the time of measurement, some BIA instrument manufacturers recommend that measurements always be made at approximately the identical time of day, thereby quasi-eliminating the need for the restrictions.

### **NIR Restrictions**

The only known possible restriction on NIR is to avoid measurements on an extremely black tattooed location. The low energy NIR light might be totally absorbed by a very black tattoo.

Except for the above restriction, NIR does not have any of the other restrictions that BIA instruments have<sup>4,5</sup>. The reason for this is NIR directly measures percent fat, whereas BIA instruments measures the water content and electrolyte content of the body and then calculates percent body fat

### **Conclusions**

Both BIA and NIR instruments can provide accuracy equal to the Gold Standard hydrostatic weighing technique for determining percent body fat. For such accuracy to occur, both measurement technologies must be used within the above describes restrictions.

**For more information on the FUTREX-6100 and Bod-eComm2 above please visit [www.futrex.com/products](http://www.futrex.com/products)**

**For more information on the Tanita MC-980 please visit <http://www.tanita.co.jp/shop/g/MC98001101/>**

**For more information on the InBody 720 by Biospace please visit <http://www.biospaceamerica.com/Product/ib720>**

### **References**

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