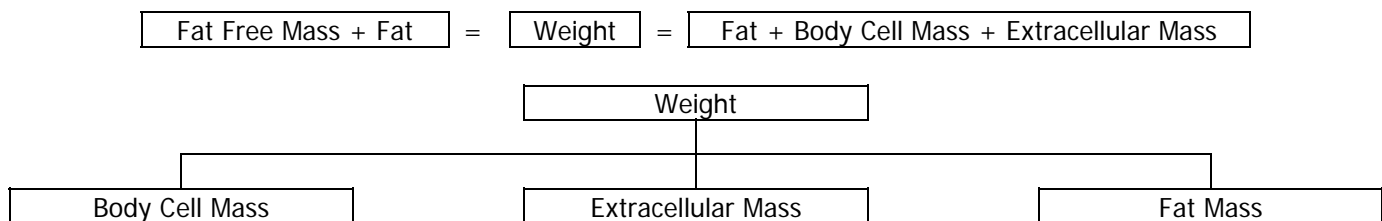


### Bioelectrical Impedance Analysis: Glossary of Terms

**Bioelectrical Impedance Analysis (BIA)** is a tool used to:

- Estimate body composition
- Monitor for wasting
- Observe trends over time
- And is a painless and bloodless procedure

**Body Weight** Total body weight is the sum of fat and fat free mass. The terms fat free mass and lean body mass are often used to mean the same thing, however lean body mass includes the fat in cell membranes. Fat free mass may account for 70 - 90% of body weight. Body weight can be divided into 3 compartments. Each compartment provides distinct and overlapping functions in the body. To better assess internal health, the analysis of the different compartments is needed.



**Body Cell Mass (BCM)** Body cell mass is the living, protein based, metabolically active tissue in the body, where more than 90% of the body's processes take place. It contains the intracellular fluid and the majority of the body's potassium. Without adequate nutrition compensation during illness, disease, aging, under-nutrition, and athletic over-training, BCM tissue is utilized and lost. Loss of this tissue is considered wasting and the timing of death in malnourished patients has been strongly correlated with the degree of body cell mass depletion independent of the underlying cause of wasting. The process of converting food into tissue and increasing body cell mass is called anabolism. The process of breaking down tissue and decreasing body cell mass is called catabolism.

Components of Body Cell Mass	% Total Body Cell Mass
Muscle tissue	60
Organs	20
Circulating cells and tissue	20

#### Population Norms for Body Cell Mass

Women: 30-35% of body weight

Men: 40-45% of body weight

**Extracellular Mass (ECM)** ECM is tissue found outside of the cell that provides body structure and support and transport. Includes bone, tendons, collagen, plasma, and extracellular fluid.

**Fat** functions as a major source of energy for the body. Fat stores help maintain body temperature and protect body organs from trauma. Dietary fat aids in the absorption of fat-soluble vitamins, adds flavor and texture to food and gives a sense of fullness and satiety.

**Total Body Water (TBW)** TBW is expressed as a percentage of weight and includes water that is inside (intracellular) and outside the cell (extracellular). TBW varies depending upon age and gender, and increases with increased muscle mass. Approximately 50 – 60% of the adult human body weight is fluid (~40 liters in a 70kg man.)

**For more information or to sign up for a nutrition class call:**

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**Intracellular Water (ICW)** Most of the body's fluid is found inside the body cell mass and contains large amounts of potassium, magnesium and phosphate ions. Changes in ICW reflect changes in BCM. An increase of ICW usually means there is an increase in BCM (anabolism). A decrease of ICW usually means there is a breakdown and loss of BCM (catabolism). ICW is usually 60% of total body water in men and 50% in women.

**Extracellular Water (ECW)** Extracellular water is the fluid outside the cell that circulates throughout the body. The ECW is included in the extracellular mass (ECM). ECW is located between the cells (interstitial), within blood vessels (intra-vascular), in lymph tissues, spinal fluid, and other spaces such as the intestines in the gastrointestinal tract. ECW contains large amounts of sodium, chloride, and bicarbonate ions, plus nutrients for the cells. ECW is usually 40% of total body water in males and 50% in women.

**How BIA Works** A small, undetectable, alternating current is passed through the body and the BIA measures the resistance to flow of the current as it passes through the body. Using specialized equations, an estimate of total body water, fat free mass and fat mass are determined.

**Resistance** All substances have resistance to the flow of an electric direct current. A good conductor has low resistance. Muscle mass contains water and electrolytes. This makes it a good conductor and therefore will have a low resistance. Fat and bone contains a low amount of water and therefore a high resistance. BIA is measuring the resistance of the body to the applied current.

**Reactance** The reactance is a measurement that reflects the strength and health of the cell wall. Essentially, it is a measure of capacitance, which is the cell wall's stored electrical charge.

**Phase Angle** The phase angle represents a mathematical relationship between resistance and reactance. Lower phase angles have been related to increased morbidity and mortality. Higher values appear to be consistent with greater body cell mass and less morbidity and mortality. Phase angle may range from 3 - 12 depending on gender. Goal for men is > 6 and women > 5.

**Basal Metabolic Rate (BMR) or Basal Energy Expenditure (BEE)** BMR or BEE is the estimated amount of energy used in 24 hours while the body is at physical, digestive and emotional rest. A formula is often used to derive BEE using weight, height, gender, and age. To determine estimated daily caloric need, the BEE is multiplied by certain factors. These factors reflect a person's current medical condition; energy used for exercise and body functions, and desired weight goals.

**Body Mass Index (BMI)** The body mass index defines a level of adiposity using only a person's weight and height without regard to gender. BMI does not account for large or small frame size or highly muscled individuals. A range of 20 to 24.9 seems to be consistent with good health, while values less than 20 may indicate malnutrition, values of 25 to 29.9 is defined as overweight and obesity is defined as a BMI of 30 and above. Obesity is a risk factor for heart disease, hypertension and type 2-diabetes.

#### **Anthropometry: Circumference and Skinfold Measurements**

Skinfolds measure double thickness of skin and subcutaneous fat and circumferences measure fat and muscle. Compare these measurements to reference tables.

Tricep Skinfold (TSF), mid-arm Circumference (MAC), and arm muscle area (AMA). AMA is calculated using the TSF & MAC.

**Summary** Bioelectrical impedance Analysis is a useful tool to assess lean body mass and its components, body cell mass and extracellular mass. Test results provide immediate feedback for early intervention for better outcomes. A BIA test is painless, non-invasive, takes only a few minutes with repeatable results.

In addition to a BIA test, body shape changes experienced by some individuals can be tracked taking waist, hip, chest, mid-arm and thigh circumferences and skinfold measurements. The current BIA predictive equations used to estimate body composition do not reflect (loss of fat in the limbs, face or buttocks, nor does BIA estimate visceral fat, the fat that surrounds organs in the abdomen or regional fat.

Resources: <http://www.rjlsystems.com/>

<http://nutrition.uvm.edu/bodycomp/bia/>

<http://nutrition.uvm.edu/bodycomp/> Very good tutorial about BIA, Dexa, underwater weighing

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